ICT ASSISTIVE TECHNOLOGY FOR THE BLIND AND VISUALLY IMPAIRED PERSONS

BY

AKOMAYE GERTRUDE ALEY
PG/UD/MSC/06/42

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF
MASTER OF SCIENCE (MSC) IN ICT
FOR THE THESIS (ICT)

SCHOOL OF POST GRADUATE STUDIES
UNIVERSITY OF NIGERIA NSUKKA
FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRONICS ENGINEERING

FEBRUARY, 2016

APPROVAL PAGE

ICT ASSISTIVE TECHNOLOGY FOR THE BLIND AND VISUALLY IMPAIRED PERSONS

AKOMAYE GERTRUDE ALEY

PG/UD/MSC/06/42

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THERE REQUIREMENTSFOR THE AWARD OF MASTER OF SCIENCE (MSC) IN THE DEPARTMENT OF ELECTRONIC ENGINEERING, UNIVERSITY OF NSUKKA

AKOMAYE, GERTRUDE ALEY SIGNATURE:---------- DATE:----------
(STUDENT)

PROFESSOR C. I. ANI SIGNATURE:---------- DATE:----------
(SUPERVISOR)

EXTERNAL EXAMINER SIGNATURE:----------DATE:----------

PROFESSOR C. I. ANI SIGNATURE:----------DATE:----------
(HEAD OF DEPARTMENT)

ENGR. PROFESSOR S. O. OBEH SIGNATURE:----------DATE:----------
(FACULTY OF ENGINEERING
POSTGRADUATE REP)

CERTIFICATION PAGE

This is to certify that this project titled, "Information and Communication Technology Assistive Technology For The Blind And Visually Impairedò has been carried out by me - **Akomaye Gertrude Aley** with registration number **PG/UD/MSC/06/42** in the UNN-DBI programme in the Department of Electronic Engineering. The information derived from the literatures has been duly acknowleged in the project and appropriate list of references provided. However, the work is original and no part of this project was previously presented either in part or in whole for the award of any degree or diploma at this or any other institution.

_____ _____

PROF C. I. ANI **PROF C. I. ANI**
SUPERVISOR HEAD OF DEPARTMENT

_____

PROF. E.S. OBE
(CHAIRMAN, FACULTY POSTGRADUATE COMMITTEE)

DECLARATION

I, Akomaye Gertrude Aley, a postgraduate student of Department of Electronic Engineering, University of Nigeria, Nsukka declare that the work embodied in this thesis is original and has not been summited by me in a part or in full for any other diploma or degree of this or any other University.

_____ _____

AKOMAYE GERTRUDE DATE

PG/UD/MSC/06/42

DEDICATION

This work is dedicated to God the Father, the Son and the Holy Spirit. All praise and honor be given unto the Lord.

ACKNOWELDGEMENT

The good old book the bible says in Philippians 4:13 I can do all things through Christ who strengthens me. This thesis in the first place would not have been possible without the help of the Almighty God who sustained my life throughout the study programme. I give glory and thanks to Him.

My special thanks and appreciation goes to my hard working supervisor Professor Cosmas Ikechkwu Ani for his patience, tolerance, understanding, suggestions, directions, constructive criticisms and valuable help throughout the cause of writing. You gave me encouragement when I lost track, you will always be remembered. I say God bless you richly.

I sincerely appreciate my family members, especially my lovely husband Mr. Emmanuel Akomaye, my kids Igor and Emmanuel (Jnr) for their astounding support and understanding throughout the period of this research. To my sisters, my in-laws and everyone whose encouragement has motivated me to accomplish the goal in research work, I appreciate you all.

I am grateful to my Colleagues at the Bureau of Public Enterprises and my friends at Digital Bridge Institute Abuja, Mrs Ijeoma Ugochukwu, Mrs Bridget Tanko Ashang, Mrs. Oby (Nee Nwoked) for your valuable contributions, I really enjoyed your company and learn much from you. I further appreciate Late Dr. Idika Ochaa, Mrs. Taiwo Adeyemi, Mr Azeez for spending their combines teaching skills with high pedigree of human touch to teach, advice and encouraged me throughout the Masters programme.

ABSTRACT

This study sought to understand the role of the Internet in information provision, within the context of other sources of information and everyday information needs. The study also presents findings about the current ways in which people who are blind and visually impaired find information for their everyday lives; the role of the Internet in this process; barriers to using computers and the assistive technologies. A system was designed and created using Visual Basic studio15 to show how information and communication has influenced the blind positively and to eliminate the digital gap. People with disabilities, and in particular people who are blind or vision impaired, are not embracing computing, Internet-related and assistive technologies at the same rate as the able-bodied population. 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 ódisability divideô 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 order to gain an understanding of the specific elements in the current disability divide, interviews were conducted with a range of government representatives, multinational information technology developers and online information providers in Nigeria. In order to gain an understanding of what people with disabilities required from information technology, a survey was conducted with people who are blind or vision impaired to determine their computing and Internet experiences. This study clearly identified that people with vision disabilities have a high level of computing and Internet expertise and it is specific barriers or disadvantages, rather than lack of will, that has prevented access to computing and available assistive technologies.

TABLE OF CONTENT

TITLE PAGE .....é é ..i
APPROVAL PAGE..... .ii
CERTIFICATION PAGE iiii
DECLARATION..... iv
DEDICATION iv
ACKNOWELDGEMENT vi
ABSTRACT viviii
TABLE OF CONTENT..... vviii-x

CHAPTER ONE: INTRODUCTION

1.0. Introduction é .é é é é 1-2

1.0.1 The Challengeé .é ..é é é ..3

1.1. Background Of The Studyé ...é é é é .é é é é é é é é é é é é .é .é é ..3-6

1.2. Statement of the Problem é é é é é é .é é é é é é é é é é é é .é .é é é .6

1.3. Research Questionsé .é .6-7

1.4. Purpose of the Studyé é é é é é é ...é é é é é é é é é é ..é .é é ...7-8

1.5. Significance of Studyé é é é é é .é é .é é é é é é é é é é é é é é .8

1.6. Scope and Limitations of Studyé é é é .é é é é é é é é é é é é é é 8-10

1.7. Definition of Termsé 10-11

CHAPTER TWO: LITERTRATURE REVIEW

2.0 The Social And Historical Context Of Disability é é é é é é é é .é é é 12-13

2.1. From Mechanical to Electrical Synthesisé é é é é ..é é é é é é ...é ...13-14

2.1.1 Development of Electrical Synthesizersé é é é é é é é é é é ..é 14-16

2.1.2 Phonetics and Theory of Speech Productioné é é é é é é é é .é ..é é ..16

2.1.3 Speech Productioné é é é é é é .é ..é é é é é é é é .é é é é .é ....é 16

2.1.4 Applications for the Blindé é é é é é é é é é é é é é é é é é é ...17-18

2.1.5 Applications for Telecommunications and Multimediaé é ..é é é é é .18-19

2.1.6 Other Applications and Future Directionsé é é é é é é é é é ...é 19

2.1.7 Text-To-Speech Applicationé é é é é é é é é é .é é é é é é ..19-20

2.1.8 Different Challenges in Individual (Disability)é é é é ..é é é é ..é ..20-22

2.1.9 Technology to Overcome Different Challengesé é é é é é é é 22

2.1.10. Visual Impairment And Blindness Fact Sheet FromWorld Health Organisationé é é é é é é é é é é é é é é é é .é é é é é ...233-26

2.1.11. Statistics and Factsheet of Disableé é é é é é é é é é .é é 26-27

2.1.12. Understanding the Concept of Visual Impairmenté é é é é é é é .27-28

2.1.13. Informationalization and the Rise of Information Divideé ..é é é é é 28-29

2.1.14. Rethinking the Digital Divideé é é é é é é é ..é é é é é é é ...29-31

2.1.15 Disability Todayé é é é é é é é é é é é é .é é é é ..é é ...é 31-33

2.1.16 Policy Approaches for People with Disabilitiesé é é é é é é é .é 33-36

2.1.17 Examples of Disability-Related Policy and Legislation Development in Western Countriesé é é é é é é é é é é é é 36-37

2.2. The Digital Divide For Visually Impaired In Nigeria é é é é é ...é é ..37-38

2.2.1 The Concept Of Assistive Technology é é é é é é é é é é é ...é é 38

2.3. Information and Communication Technology (ICT) and Assistive Technologies (AT)é é é é é é é é é é é é é ..é é 39-41

2.3.1 Modes of Information Access By Visually Disabled People..é é ..é é ...42-44

2.3.2 Conclusion...é ...44-45

CHAPTER THREE: RESEARCH METHODOLOGY SYSTEM, ANALYSIS AND DESIGN

3.0. Introductioné é é é é ..é é é é é é é é é é é é é é é é é é ....é é .46

3.1 Sample Selection Procedureé é é é é é é é é ...é é é é .é é é é é ..46

3.2. The Survey Designé é é é é é é é é é é ..é é é é é ..é é é é ...46-47

3.3. Sampling Technique and Survey Distribution.é é é é é é é é .é é é é ...47

3.4. Response to the Survey.é é é é é é é é é é é é é é é é ...é é é é é 47

3.5. Data Analysis and Presentation é é é é é ..é é é é é é é é é é é .é é .47

3.6. Review of existing system /procedure é é é é é é é é é é é é .é é é é .47

3.7 Problem of the existing systemé é é é é é é é é é é é é é .é é é é .48

3.8 System Analysis and Designé é é é é é é é é é é é é é .é é é 48-49

3.9 Input Specificationsé é é é é é é é é é é é é ..é é é é é é é ..50

CHAPTER FOUR: PRESENTATION OF FINDINGS AND SYSTEM IMPLEMENTATION

4.1. DEMOGRAPHIC INFORMATION é é é é é é é é é ..é é é é é ..51-53

4.1.1 Gender Distribution 52

4.1.2 Age Distribution .....é .52

4.1.3 Educational Status .....é é é é é é é é é é é é é é é é é é ..53

4.2. Assess the Level of Awareness and Adoption of the Assistive Technology by the Blind and Visually Impairedé ...é é é é é .é é é 53-57

4.3 Major Challenges Facing the Blind and Visually Impaired With Respect to Harnessing the ICT Support Servicesé é é é é é é ..é .57-58

4.4 System Implementationé é é é é é é é é é é é é é é é é é ..58-60

CHAPTER FIVE: SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1 Summary é é é é é é é é é é é .é é é é é é é é é é é .é .é é 61

5.2 Conclusion é é é é é é é é é ..é é é é é é é é é é é é ..é é 62

5.3 Recommendations é é é é ...é é é é é é é é é ...é é é é é ..é 62-63

REFERENCES é 64-66

APPENDIX i: Questionnaire é é é é .é é é é é é é é é é é é é ..é ..67-68

APPENDIX ii: List Of Schools For The Blind In Nigeria é é é é é é é é é ..69

APPENDIX iii: System Flowchart..é é é é é é é é é é é é é é ..é 70

APPENDIX iv: Program Flowchart 1é é é é é é é ...é é é é é .é é é é é ...71

APPENDIX v: Program Flowchart 2é é é é é é é é ...é é é é é é é é é ..é 72

APPENDIX vi: Program Interfaces é é é é é é é é é ...é é é é é é é é ..73-74

APPENDIX vii: Program Source Code é é é é é é é é ...é é é é ..é é é ..75-83

CHAPTER ONE

INTRODUCTION

1.0 . Introduction

Much of everyday life involves the activity of moving from one place to another. Unfortunately, in many countries, facilities such as shops, leisure and sports centers are increasingly being located outside the centers of population. For visually impaired and blind people, most of whom are not able to drive, access to such locations depends on the availability of public transport and, in many cases, the assistance of a human guide. In addition, there is a tendency for people to live away from their workplace and, at least in the industrialized countries, increasing numbers of people are travelling abroad on holiday. Thus, the ability to travel at least short and medium distances and find oneôs way around public spaces and commercial centers is important for personal independence, for employment and for participating in shopping and leisure activities. Consequently, visually impaired and blind people need assistive technology systems to support effective travel and to contribute to independent living and working. Further, the design of urban and other environments should be improved to make them easy to move around and obstacles that could endanger safety, particularly of visually impaired and blind people, should be removed. This is likely to have benefits for everyone, whether visually impaired, blind or sighted. Travelling, even for relatively simply trips, involves a number of different activities which are most easily carried out using vision. Consider a journey across a city by bus to visit a hospital consultant. The tasks involved include the following:

- Being able to avoid obstacles on the pavement.
- Walking in the right direction.
- Crossing the road safely.
- Finding the correct bus stop.
- Knowing which the right bus is.
- Paying the correct fare.
- Finding a vacant seat.
- Knowing when to get off the bus.

- Crossing the road safely (at a different location and probably no crossing at all).
- Walking to the hospital entrance.
- Finding the main reception desk.
- Finding and using a lift (elevator) to the correct floor.
- Locating the waiting room and the consultantôs room.

Blindness and visual impairments are common disabilities in all countries of the world. Nigeria is no exception to this phenomenon. The total population of Nigerians is estimated at 150 million people (Federal Office of Statistics, 2006), with blind and visually impaired persons numbering at least 1.5 million [19]. It is also estimated that of this figure, more than 25,000 persons are of school age, and less than 10 percent of these actually attend school, with the remaining 90 percent confined to houses or roaming the streets as beggars [20]. For the small percentage of blind and visually impaired persons in schools from primary to tertiary levels, there is no adequate provision of reading and information materials. The need to produce enough reading and information materials in alternative formats for blind and visually impaired studentsô at all educational institutions in Nigeria is steadily gaining momentum. This is a consequence of the federal government policy (Federal Ministry of Education, 1981) of equitable educational provision for all children, regardless of their physical, mental, or emotional disabilities. This policy encouraged an overwhelming increase in school enrollment for blind and visually impaired students.

In Nigeria today blind and visually impaired students are found at all educational institutions primary and secondary schools, polytechnics, universities, and vocational training centers. They, like their sighted counterparts, are in search of academic laurels. Unfortunately, the production and distribution of information resources in alternative formats to meet the needs of these blind and visually impaired students is haphazard and uncoordinated. The reason may be attributed to the fact that there is no national library service for blind and visually impaired persons in Nigeria.

1.0.1 The Challenge

Although there is no national library service there is a myriad of organizations involved in attempting to meet the needs of the blind and visually impaired, as set out in **Table 1**. The author was successful in winning the Ulverscroft Foundation/ International Federation of Library Associations (IFLA) Libraries for the Blind Section's Institutional Best Practice Award in 2003, in order to address the challenge of systematically auditing and recording the national provision of alternative format materials in Nigeria.

Federal Government Involvement: Educational Provision and Library Services

The federal government's involvement has tended more toward establishing educational institutions to train special teachers rather than providing information material or library services. The establishment of the Federal College of Education (Special) (1977) and the Department of Special Education in the Universities of Ibadan (1974), Jos (1977), Bayero, Calabar, and Uyo attest to this fact. Government involvement in providing library services is minimal.

1.1. BACKGROUND OF THE STUDY

Information Communication Technology (ICT) has tremendous positive impacts and application in all facets of human endeavor. ICT is acclaimed the solution to most endeavor as it eases procedures to produce effective results. Particularly, ICT is supposed to bridge the information gap between people with disabilities (especially the Blind and Visually Impaired), and their óable-bodiedô counterparts.

Technology has removed many barriers to education and employment for visually impaired individuals. Students with visual impairments can complete homework, do research, take tests, and read books along with their sighted classmates, thanks to advances in technology. Adults with visual impairments can continue to work and pursue a tremendous range of careers because of the use of computers and other devices. [17]

These include:

Assistive technology programs that run on off-the-shelf computers can speak the text on the screen or magnify the text in a word processor, web browser, e-mail program or other application

Stand-alone products designed specifically for people who are blind or visually impaired, including personal digital assistants (PDAs) and electronic book players provide portable access to books, phone numbers, appointment calendars, and more.

Optical character recognition systems scan printed material and speak the text. Braille embossers turn text files into hard-copy braille.

This research work will provide a wealth of information and advice for acquiring and using assistive technology effectively and design voice application for the blind [17].

The development of the Graphical User Interface (GUI), provided a more accessible computing environment for a majority of users, but ironically left the Internet more inaccessible to some disability or physically challenged groups, especially, the blind and visually impaired. Thus, ICT further widened the digital divide for the blind and visually impaired, considering the fact that the input, processing and output of ICT systems rely greatly on GUI, which places them at a disadvantage. The rapid arrival of the Internet into the public realm changed the perceived importance of computing.
The Internet added a vital information and communication resource to personal computers. The widening gap between people who were able to access this new technology in comparison to groups in society who were unable to access the technology is generally referred to as the digital divide. This digital divide is wider for the blind and visually impaired people. Nevertheless, there are information technology solutions to the problem of digital divide intrinsic with ICT.
The arrival of computing and assistive technology creates the potential for blind and visually impaired people to gain access to resources previously denied, including internet. Assistive Technologies and/or Adaptive Technologies are born out of necessity for enhancing accessibility for the Blind and Visually Impaired, as well as promoting of the rights of the blind and visually impaired. Such assistive

technologies includes but not limited to: text-to-speech software, magnification accessibility features, computer keyboard based on braille keys with direct translation, talking web browsers, electronic travel devices, talking watches, phones with text readers and voice dialing, etc.

World Health Organization states that there is a paucity of data on the prevalence and causes of blindness and visual impairment in African countries, as very few have data at the national level. Such data are essential for planning services for the realization of the goals of VISION2020: the global Right to Sight initiative posited that, Nigeria is the most populous country in Africa with an estimated population of 160 million which also makes it the ninth most populous country in the world [1]. This statistics, reported that ñover 1 million adults are blind and another 3 million are visually impairedò. This population of blind persons accounts for approximately 3% of the total population. It is also estimated that of this figure, more than 25,000 persons are of school age, and less than 10 percent of these actually attend school, with the remaining 90 percent confined to houses or roaming the streets as beggars [2].

In Nigeria today, there presently exist 28 (twenty-eight) dedicated schools and special centers for the blind to carter for the special education need of the blind. More so, blind and visually impaired students are found at all educational institutions in primary and secondary schools, polytechnics, universities, and vocational training centers. They, like their sighted counterparts, are in search of academic laurels in a quest for excellence and a chance to be productively involved in nation building, while maintaining some level of independence such that they donôt become liabilities to others.

Another vulnerable group with prevalence of visual impairment are persons with ocular albinism (albino). The population of Albino in Nigeria stands at 4 million. Out of this figure, 2 million persons are with ocular albinism, while those with full albinism are over 2 million. Persons with ocular albinism usually have normal skin pigmentation but loss of melanin in the eyes, which causes some form of visual impairments [4]. This accounts for another estimated 3% of Nigeriaôs population.

Within contemporary Nigerian society, there is little appreciation that disability is fundamentally an issue inexorably linked to and rooted in human rights. The common perception, held by policy-makers and the public at large, is that disabled people and disability issues are viewed in terms of charity and welfare. The blind and visually

impaired have a right to education and information resource available on the internet. Using the appropriate assistive technology available, the blind and visually impaired can be helped to bridge the digital divide and education gap.

1.2. Statement Of The Problem

Despite the power and enormous capability of Information Communication Technology, the intrinsic digital divide it creates and the extenuating assistive technologies, the blind and visually impaired in Nigeria are yet to fully harness this dimension of ICT. The blind and visually impaired in developed world have since embraced this and have increased their productivity, ensured their rights and enhanced social inclusion in society. This is far from the case in developing countries like Nigeria; there is a paucity of data on the level of awareness and adoption of assistive technology by the blind and visually impaired. This thesis therefore carry out an assessment study of the ICT support services for the blind and visually impaired in Nigeria. The study also focused on what the latest technology to assist blind and vision-impaired people are and if the voice Application for the blind can bridge this gap.

The aim was to use qualitative techniques to understand the perceptions of people about the new technology. The future jobs of thousands of visually disabled people, their ability to use labor saving household appliances, and their capacity to deal electronically with the rest of the world is at stake [5].

1.3. Research Questions

The research questions for this study are as follows:

- How do people with vision disabilities perceive themselves and society, and how does this affect access to computing and Assistive technologies?

ÅWhat are the barriers preventing blind and vision impaired from using Computers and Assistive Technology?

ÅAre computing and Internet-related technologies beneficial to people with vision disabilities?

ÅAre computing and assistive technologies providing effective tool for people with vision impairment?

ÅIn what way do government policies, online information providers and information technology corporations affect the disability divide?

ÅHow can issues related to the disability divide be resolved?

1.4. Purpose of the Study

The main aim of this thesis is to carry out an inclusive assessment of the ICT support services available to assist the blind and visually impaired to bridge the digital divide. To achieve this aim, the following objectives are paramount

1. Critically assessment of the assistive technologies specifically designed to bridge the digital divide for the blind and visually impaired
2. Assess the level of awareness and adoption of the assistive technology by the blind and visually impaired.
3. Identify major challenges facing the blind and visually impaired with respect to harnessing the ICT support services.

4 To demonstrate on the system ways in which Internet technologies provide advantages for people with vision disabilities;

5 To develop a clear understanding of the ways in which people with vision disabilities perceive, establishing the extent and nature of perceived barriers or benefits;

6 To determine the effect of government policy and corporate initiatives on the issues surrounding the disability divide; and

7 To investigate and determine the effectiveness of Internet-related products or assistive technologies are available to assist people with vision impaired;

8 Proffer ICT solutions to challenges facing the blind and visually impaired by Designing and implement a system as a solution to bridge the gap of existing technology

1.5. Significance of Study

Before now, the blind and visually impaired in Nigeria are relegated to beg or remain liabilities to those they depend on. They are viewed in terms of charity and welfare. The effort of few brilliant blind and visually impaired to earn education and use information resource are not very fruitful because of their disability challenge. This thesis assesses the assistive technology required to bridge the digital divide and information gap. The assessment would help to provide the much needed data for promoting the adoption and proper harnessing of assistive technology for the blind and visually impaired. This research would also provide the framework for proper policy legislation to ensure the rights of the blind and visually impaired as well as promote social inclusion and higher productivity by this class of people.

This study investigates and design a system to show the ways in which the Internet and assistive technology, while promising much assistance to many people who are blind or vision impaired, has become yet another arena in which disability leads to inequalities in society. In the course of the investigation, this study has sought to discover the ways in which this digital divide for people with vision disabilities, referred to as the disability divide, can be bridged. The significance of this project work also serve as a helping tools for the vision impaired people, therefore, this goes a long way by creating a voice application. The blind will use the software to voice out what they have type.

1.6. Scope and Limitations of Study

The scope of this research work converts text into spoken word, by analyzing and processing the text using Natural Language Processing (NLP) and then using Digital Signal Processing (DSP) technology to convert this processed text into synthesized speech representation of the text.

This study also investigates and designs a system to show the ways in which the Internet, while promising much assistance to many people who are blind or vision impaired, has become yet another arena in which disability leads to inequalities in society. In the course of the investigation, this study has sought to discover the ways in which this digital divide for people with vision disabilities, referred to as the disability divide, can be bridged.

The specific research objectives were:

1. Critically assessment of the assistive technologies specifically designed to bridge the digital divide for the blind and visually impaired
2. Assess the level of awareness and adoption of the assistive technology by the blind and visually impaired.
3. Identify major challenges facing the blind and visually impaired with respect to harnessing the ICT support services
4. To demonstrate on the new system ways in which assistive technologies provide advantages for people with vision disabilities;
5. To develop a clear understanding of the ways in which people with vision disabilities perceive, establishing the extent and nature of perceived barriers or benefits;
6. To determine the effect of government policy and corporate initiatives on the issues surrounding the disability divide; and
7. To investigate and determine the effectiveness of Internet-related products or assistive technologies are available to assist people with vision impaired;
8. To propose solutions that will help close the disability divide in relation to Internet use, assistive technology and access between people with and without a disability.

One of the limiting factors to the study was that only a few people with visual impairments were interviewed because it was not possible to go to many as States or location as possible due to time constraints. Regardless of this limitation, the findings

are consistent with the local and international literature. Therefore, the findings of the study may be generalized.

1.7. Definition of Terms

For the purpose of this study, key terms are used as follows;

Assistive technology: A broad term used to describe both the products and services given to the individuals with Special Education Needs (SEN) to enhance their vocation, recreation, education and independence.

Braille: A system of writing that involves a combination of six embossed dots.

Career: Activities and positions involved in vocations, occupations as well as related activities associated with an individualôs life time of work.

Career choice: The act of selecting a career.

Career development: The interaction of psychological, sociological, economical, physical and chance factors that shape the sequence of identifying, selecting and maintaining a career engagement throughout oneôs lifetime.

Career guidance: Provision of services and activities to individuals of any age and at any point throughout their lives to help them make educational, training and occupational choices.

Disability: A restriction or disadvantage imposed on an individualôs functioning as a result of impairment.

Guidance: The help or advice given to someone about their work, education or personal life.

Impairment: An identifiable defect in the basic functions of an organ or any part of the body system.

Self-perception: A personôs view of themselves and of a mental or physical attribute that makes up the self.

Parent: A person acting as a father or mother; guardian.

Self: The term for oneôs experience or image of one self, developed through interactions with others.

Self-actualization: Psychological need to develop onesô capabilities and potential in order to enhance personal growth.

Self-concept: An individualôs view of himself or herself, consisting of attitudes, feelings, beliefs, perceptions, behaviors and other characteristics that are uniquely onesô own.

Self-esteem: The value or judgment individuals place on their behavior.

Self-efficacy: The belief that one can successfully execute behavior required to produce a particular out come.

Switchboard operating: Receiving and connecting telephone messages to recipients.

Visual impairment: Vision loss (of a person) either partial or total resulting from disease, trauma, or congenital or degenerative conditions that cannot be corrected by conventional means such as refractive correction, medication or surgery.

CHAPTER TWO

LITERTRATURE REVIEW

2.0 The Social and Historical Context of Disability

This chapter focuses on the historical development of the concept of disability. Since the 1970s, society has made significant progress towards achieving equity between people with disabilities and the able-bodied population. However, despite such progress, many people continue to struggle with issues of poverty, unemployment and a lack of educational opportunities. Such issues continue to extend far and beyond that experienced by their able-bodied counterparts.

The fact that disability is a fluid, ever-changing concept demonstrates that perception plays an important role in the creation of policy and ultimately the development of disability-related tools and resources. It is therefore necessary to understand disability within its past and present context when exploring and researching areas relating to the treatment of people with disabilities. For people who are blind or vision impaired, there is an additional difficulty. In addition to specific mobility and learning difficulties, there is a general perception of fear associated with blindness which contributes to the increased difficulties of this group.

This chapter contributes to this research by identifying the current role of disability in society, and demonstrates how the current role has evolved from changing social categories. In addition, this chapter explores the interrelationship between the social construction of disability and the creation of policy with an emphasis on people who are blind or vision impaired. In this chapter, the history of synthesized speech from the first mechanical efforts to systems that form the basis for today's high-quality synthesizers is discussed. Some separate milestones in synthesis-related methods and techniques will also be discussed briefly for purposes of information. In chapter one under the section rational of the study, I attempted to argue for the importance of this study. This has paved the way for me at this juncture to review available literature in connection with the topic; inclusion of the visually impaired.

Text-to-speech (TTS) convention transforms linguistic information stored as data or text into speech. It is widely used in audio reading devices for blind people now days.

In the last few years however, the use of text-to-speech conversion technology has grown far beyond the disabled community to become a major adjunct to the rapidly growing use of digital voice storage for voice mail and voice response systems. Also developments in Speech synthesis technology for various languages have already taken place. Many speech synthesizers using complex neural networks have also been designed. In the bigger picture, the module can open up a window of opportunities for the less privileged paving the way for a plethora of employment opportunities for them in the job sector. It can also play a defining role in establishing communication of the blind if it is incorporated into mobile phones so that text messages could be converted into speech.

Artificial speech has been a dream of the humankind for centuries. To understand how the present systems work and how they have developed to their present form, a historical review may be useful.

2.1 From Mechanical to Electrical Synthesis

The earliest efforts to produce synthetic speech were made over two hundred years ago. In St. Petersburg 1779 Russian Professor Christian Kratzenstein explained physiological differences between five long vowels (/a/, /e/, /i/, /o/, and /u/) and made apparatus to produce them artificially. He constructed acoustic resonators similar to the human vocal tract and activated the resonators with vibrating reeds like in music instruments [21]. A few years later, in Vienna 1791, Wolfgang von Kempelen introduced his "Acoustic-Mechanical Speech Machine", which was able to produce single sounds and some sound combinations [21]. In fact, Kempelen started his work before Kratzenstein, in 1769, and after over 20 years of research he also published a book in which he described his studies on human speech production and the experiments with his speaking machine. The essential parts of the machine were a pressure chamber for the lungs, a vibrating reed to act as vocal cords, and a leather tube for the vocal tract action. By manipulating the shape of the leather tube he could produce different vowel sounds. Consonants were simulated by four separate constricted passages and controlled by the fingers. For plosive sounds he also employed a model of a vocal tract that included a hinged tongue and movable lips.

His studies led to the theory that the vocal tract, a cavity between the vocal cords and the lips, is the main site of acoustic articulation. Before von Kempelen's demonstrations the larynx was generally considered as a center of speech production. Kempelen received also some negative publicity.

While working with his speaking machine he demonstrated a speaking chess-playing machine. Unfortunately, the main mechanism of the machine was concealed, legless chess-player expert. Therefore his real speaking machine was not taken seriously as it should have [21].

In about mid 1800's Charles Wheatstone constructed his famous version of von Kempelen's speaking machine which is shown in Figure 2.2. It was a bit more complicated and was capable to produce vowels and most of the consonant sounds. Some sound combinations and even full words were also possible to produce. Vowels were produced with vibrating reed and all passages were closed. Resonances were affected by deforming the leather resonator like in von Kempelen's machine. Consonants, including nasals, were produced with turbulent flow through a suitable passage with reed-off.

The connection between a specific vowel sound and the geometry of the vocal tract was found by Willis in 1838 (Schroeder 1993). He synthesized different vowels with tube resonators like organ pipes. He also discovered that the vowel quality depended only on the length of the tube and not on its diameter.

2.1.1 Development of Electrical Synthesizers

The first full electrical synthesis device was introduced by Stewart [22]. The synthesizer had a buzzer as excitation and two resonant circuits to model the acoustic resonances of the vocal tract. The machine was able to generate single static vowel sounds with two lowest formants, but not any consonants or connected utterances. Same kind of synthesizer was made by Wagner. The device consisted of four electrical resonators connected in parallel and it was excited by a buzz like source. The outputs of the four resonators were combined in the proper amplitudes to produce vowel spectra. In 1932 Japanese researchers Obata and Teshima discovered the third

formant in vowels. The three first formants are generally considered to be enough for intelligible synthetic speech [21].

First device to be considered as a speech synthesizer was VODER (Voice Operating Demonstrator) introduced by Homer Dudley in New York World's Fair 1939 [21] VODER was inspired by VOCODER (Voice Coder) developed at Bell Laboratories in the mid-thirties. The original VOCODER was a device for analyzing speech into slowly varying acoustic parameters that could then drive a synthesizer to reconstruct the approximation of the original speech signal. The VODER consisted of wrist bar for selecting a voicing or noise source and a foot pedal to control the fundamental frequency. The source signal was routed through ten band pass filters whose output levels were controlled by fingers. It took considerable skill to play a sentence on the device. The speech quality and intelligibility were far from good but the potential for producing artificial speech were well demonstrated. The speech quality of VODER is demonstrated in accompanying CD (track 01).

About a decade later, in 1951, Franklin Cooper and his associates developed a Pattern Playback synthesizer at the Haskins Laboratories [21]. It reconverted recorded spectrogram patterns into sounds, either in original or modified form. The spectrogram patterns were recorded optically on the transparent belt (track02).

The first formant synthesizer, PAT (Parametric Artificial Talker), was introduced by Walter Lawrence in 1953 PAT consisted of three electronic formant resonators connected in parallel. The input signal was either a buzz or noise. A moving glass slide was used to convert painted patterns into six time functions to control the three formant frequencies, voicing amplitude, fundamental frequency, and noise amplitude (track 03). At about the same time Gunnar Fant introduced the first cascade formant synthesizer OVE I (Orator Verbis Electris) which consisted of formant resonators connected in cascade (track 04). Ten years later, in 1962, Fant and Martony introduced an improved OVE II synthesizer, which consisted of separate parts to model the transfer function of the vocal tract for vowels, nasals, and obstruent consonants.

Possible excitations were voicing, aspiration noise, and frication noise.

The first full text-to-speech system for English was developed in the Electrotehnical Laboratory, Japan 1968 by Noriko Umeda and his companions Klatt It was based on an articulatory model and included a syntactic analysis module with sophisticated heuristics. The speech was quite intelligible but monotonous and far away from the quality of present systems (track 24).

2.1.2 Phonetics and Theory of Speech Production

Speech processing and language technology contains lots of special concepts and terminology. To understand how different speech synthesis and analysis methods work we must have some knowledge of speech production, articulatory phonetics, and some other related terminology. The basic theory of these topics will be discussed briefly in this chapter.

2.1.3 Speech Production

Human speech is produced by vocal organs presented in Figure 3.5. The main energy source is the lungs with the diaphragm. When speaking, the air flow is forced through the glottis between the vocal cords and the larynx to the three main cavities of the vocal tract, the pharynx and the oral and nasal cavities. From the oral and nasal cavities the air flow exits through the nose and mouth, respectively. The V-shaped opening between the vocal cords, called the glottis, is the most important sound source in the vocal system.

The vocal cords may act in several different ways during speech. The most important function is to modulate the air flow by rapidly opening and closing, causing buzzing sound from which vowels and voiced consonants are produced. The fundamental frequency of vibration depends on the mass and tension and is about 110 Hz, 200 Hz, and 300 Hz with men, women, and children, respectively. With stop consonants the vocal cords may act suddenly from a completely closed position in which they cut the air flow completely, to totally open position producing a light cough or a glottal stop.

On the other hand, with unvoiced consonants, such as /s/ or /f/, they may be completely open. An intermediate position may also occur with for example phonemes like /h/.

2.1.4 Applications for the Blind

Probably the most important and useful application field in speech synthesis is the reading and communication aids for the blind. Before synthesized speech, specific audio books were used where the content of the book was read into audio tape. It is clear that making such spoken copy of any large book takes several months and is very expensive. It is also easier to get information from computer with speech instead of using special bliss symbol keyboard, which is an interface for reading the Braille characters.

The first commercial TTS application was probably the Kurzweil reading machine for the blind introduced by Raymond Kurzweil in the late 1970's. It consisted of an optical scanner and text recognition software and was capable to produce quite intelligible speech from written multifont text. The prices of the first reading machines were far too high for average user and these machines were used mostly in libraries or related places. Today, the quality of reading machines has reached acceptable level and prices have become affordable for single individual, so a speech synthesizer will be very helpful and common device among visually impaired people in the future. Current systems are mostly software based, so with scanner and OCR system, it is easy to construct a reading machine for any computer environment with tolerable expenses.

Regardless of how fast the development of reading and communication aids is, there is always some improvements to do.

The most crucial factor with reading machines is speech intelligibility which should be maintained with speaking rates ranging from less than half to at least three times normal rate [21]. Naturalness is also an important feature and makes the synthetic speech more acceptable. Although the naturalness is one of the most important features, it may sometimes be desirable that the listener is able to identify that speech is coming from machine [21], so the synthetic speech should sound natural but somehow "neutral".

When the output from a speech synthesizer is listened for the first time, it may sound intelligible and pleasant. However, during longer listening period, single clicks or

other weak points in the system may arise very annoying. This is called an annoying effect and it is difficult to perceive with any short-term evaluation method, so for these kind of cases, the feedback from long-term users is sometimes very essential.

Speech synthesis is currently used to read www-pages or other forms of media with normal personal computer. Information services may also be implemented through a normal telephone interface with keypad-control similar to text-tv. With modern computers it is also possible to add new features into reading aids. It is possible to implement software to read standard check forms or find the information how the newspaper article is constructed. However, sometimes it may be impossible to find correct construction of the newspaper article if it is for example divided in several pages or has an anomalous structure.

A blind person cannot also see the length of an input text when starting to listen it with a speech synthesizer, so an important feature is to give in advance some information of the text to be read. For example, the synthesizer may check the document and calculate the estimated duration of reading and speak it to the listener. Also the information of bold or underlined text may be given by for example with slight change of intonation or loudness.

2.1.5 Applications for Telecommunications and Multimedia

The newest applications in speech synthesis are in the area of multimedia. Synthesized speech has been used for decades in all kind of telephone enquiry systems, but the quality has been far from good for common customers. Today, the quality has reached the level that normal customers are adopting it for everyday use.

Electronic mail has become very usual in last few years. However, it is sometimes impossible to read those E-mail messages when being for example abroad. There may be no proper computer available or some security problems exist. With synthetic speech e-mail messages may be listened to via normal telephone line. Synthesized speech may also be used to speak out short text messages (SMS) in mobile phones.

For totally interactive multimedia applications an automatic speech recognition system is also needed. The automatic recognition of fluent speech is still far away, but

the quality of current systems is at least so good that it can be used to give some control commands, such as yes/no, on/off, or ok/cancel.

2.1.6 Other Applications and Future Directions

In principle, speech synthesis may be used in all kind of human-machine interactions. For example, in warning and alarm systems synthesized speech may be used to give more accurate information of the current situation. Using speech instead of warning lights or buzzers gives an opportunity to reach the warning signal for example from a different room. Speech synthesizer may also be used to receive some desktop messages from a computer, such as printer activity or received e-mail.

In the future, if speech recognition techniques reach adequate level, synthesized speech may also be used in language interpreters or several other communication systems, such as videophones, videoconferencing, or talking mobile phones. If it is possible to recognize speech, transcribe it into ASCII string, and then re synthesize it back to speech, a large amount of transmission capacity may be saved. With talking mobile phones it is possible to increase the usability considerably for example with visually impaired users or in situations where it is difficult or even dangerous to try to reach the visual information. It is obvious that it is less dangerous to listen than to read the output from mobile phone for example when driving a car.

During last few decades the communication aids have been developed from talking calculators to modern three-dimensional audiovisual applications.

2.1.7 Text-To-Speech Application

Text-To-Speech Apps Aid Students with Dyslexia

Voxdox, a text-to-speech app, aims to help children and adults with learning disabilities such as dyslexia or alexia.

Speech synthesis, commonly known as text-to-speech (TTS), is the artificial production of human speech. Nowadays you can find a number of apps and programs that use a speech synthesizer to provide a text-to-speech service. Perhaps the most famous beneficiary of speech synthesis is the physicist and author Stephen Hawking, who communicates through a speech-generating device.

A number of apps can turn text into speech, but a few have been specifically designed to assist children and adults with learning disabilities such as dyslexia or alexia.

According to Baror), the feedback has generally been very positive. While refusing to reveal exact numbers, he says that children who have used the app have shown a significant improvement in test scores. In addition to its emphasis on universities and high schools, what makes Voxdox unique compared to text-to-speech competitors such as Voice Dream Reader and Notability?

"Compared to other similar apps in the market, Voxdox comes with a text-to-speech and an electronic reader," Baror explained. "Instead of forcing the user to use two apps simultaneously -- one for speech and one for reading -- Voxdox includes both elements, enabling users to get all the service from one app."

While Baror and Voxdox continue to perfect their product, schools and other educational institutions have begun to further explore the potential of text-to-speech technology. News media outlets are also looking into educational tools and gadgets that offer assistive functions.

According to a recent NBC report, text-to-speech apps help students who struggle with learning difficulties keep up with their peers. "These gadgets can give students a sense of self-efficacy, being in charge of their own learning," James H. Wendorf, executive director of the National Center for Learning Disabilities, told NBC.

Instead of being viewed as a crutch, perhaps text-to-speech devices and apps should be seen as yet another example of how technological innovations can improve users' quality of life and help many students to reach their full potential.

2.1.8 Different Challenges in Individual (Disability)

People living with some form of impairments or disabilities in Nigeria today go through many challenges, both in public and private places. Disability is believed to be the consequence of an impairment that may be physical, cognitive, mental, sensory, emotional, developmental, or some combination of these. Disabilities are an umbrella term, covering impairments, activity limitations, and participation restrictions. An individual may also qualify as disabled if he/she has had impairment in the past or is seen as disabled based on a personal or group standard or norm. Such

impairments may include physical, sensory, and cognitive or developmental disabilities. Mental disorders (also known as psychiatric or psychosocial disability) and various types of chronic disease may also qualify as disabilities. The National President, Joint National Association of Persons with Disabilities (JONAPWD) and national confab delegate, Ekaete Judith Umoh believes that the cause of disability is as a result of the negative interaction with the people with physical impairment. ñDisability are those things that prevent people with impairment from functioning properly in the society. Yes, it might be true that a person is blind. Yes, it might be true that a person might be using a wheel chair, but it is not true that such as totally useless in the society. It is because the society has failure to realize the diverse nature of the society and therefore failed to make provision to accommodate my needs. That is why this is a disabilityò, she said.

Available world report has it that about 15% of the population of any country is living with disabilities. What this means is that 15% of Nigerian population is presently living with disabilities. It is also believed that in developing countries where you have incessant wars, diseases, the figure could be much higher.

Experts believe that the causes of impairment could be anything. It could be disease. It could be sickness like polio and others. Every human being is vulnerable to disease and attack. But when you are subjected to any disease or attack and you lose any member of your body or any member of your body does not allow you to use it to the fullest potential, impairment has set in. Recently there have been outcries by many Nigerians on the negative attitude towards people living with one form of disability or the other.

According Wilson, ñPeople who have impairment in Nigeria go through a lot of obstacles and barriers. They have environmental barrier, architectural barrier, institutional barrier and attitudinal barriers. We know that many pretty girls with disability may not easily get spouseò Wilson who is a delegate to the on-going national conference frowned that government policies and programmes have failed to take into consideration people with disability in the society. Publisher, Qualitative Magazine, a disability advocacy magazine, Agbo Christian Obiora, told Leadership Weekend that the major problems being faced by people with disabilities in the country come from the populace, and not even the disabled themselves. ñPeople living

with disabilities are not actually the problem, because they contribute only 20% to the problem of stigmatization in the society. The other 80% is contributed by the society at largeò. He continued: ñThe society often finds it difficult to accept people with disabilities into the society properly. When people see you with clutches or wheelchairs or walking sticks, they are often blindfolded from seeing other potentials in you. At times the society sees you as if you are the cause of the problem or that you brought the disability upon yourself [25].

2.1.9 Technology to Overcome Different Challenges

One of the disabled students at an information technology (IT) course answered, when asked why he was doing the course, ñI want to show the world that, though it may be true that I am disabled, I am not disqualified.ò ñDisabled but not disqualifiedò ï this is the motto under which governments, organizations, non- governmental organizations (NGOs) and private sectors are working together to enable persons with disabilities (PwDs) to become integrated into mainstream society so that they may realize their full potential.

With the advent of information and communications technology (ICT), new hopes are emerging for PwDs. Despite the huge challenges, sincere efforts are being undertaken to implement the use of ICT to counter obstacles related to disability. The information society represents at once significant opportunities but also potential new barriers for the social inclusion of disabled people. Information and communications technology and assistive technology offer new opportunities for everyone, but these opportunities are specifically more significant for PwDs, who use assistive technology for their daily activities to a higher extent than people in general. Todayôs assistive technology, which is adapted to everyoneôs abilities, means that disabled end users are able to participate in all aspects of social life on more equal terms than ever before. It is vital that people are able to benefit on an equal basis from the rapid development of ICT, to enable them to partake in an inclusive and barrier free information society.

2.1.10 Visual Impairment and Blindness Fact Sheet from World Health Organisation

As at August 2014, 285 million people are estimated to be visually impaired worldwide: 39 million are blind and 246 have low vision.

About 90% of the world's visually impaired live in low-income settings. 82% of people living with blindness are aged 50 and above [18].

Globally, uncorrected refractive errors are the main cause of moderate and severe visual impairment; cataracts remain the leading cause of blindness in middle- and low-income countries.

The number of people visually impaired from infectious diseases has reduced in the last 20 years according to global estimates work. 80% of all visual impairment can be prevented or cured [18].

There are 4 levels of visual function, according to the International Classification of Diseases -

- Normal Vision
- Moderate Visual Impairment
- Severe Visual Impairment
- Blindness.

Moderate visual impairment combined with severe visual impairment are grouped under the term ñlow visionò: low vision taken together with blindness represents all visual impairment.

Globally the major causes of visual impairment are: uncorrected refractive errors (myopia, hyperopia or astigmatism), 43 % unoperated cataract, 33% glaucoma, 2%.

Approximately 90% of visually impaired people live in developing countries.

About 65 % of all people who are visually impaired are aged 50 and older, while this age group comprises about 20 % of the world's population. With an increasing elderly population in many countries, more people will be at risk of visual impairment due to chronic eye diseases and ageing processes.

An estimated 19 million children are visually impaired. Of these, 12 million children are visually impaired due to refractive errors, a condition that could be easily diagnosed and corrected. 1.4 million are irreversibly blind for the rest of their lives and need visual rehabilitation interventions for a full psychological and personal development.

Overall, visual impairment worldwide has decreased since the early estimates in 1990s. This is despite an ageing global elderly population. This decrease is principally the result of a reduction in visual impairment from infectious diseases through: overall socioeconomic development; concerted public health action; increased availability of eye care services; awareness of the general population about solutions to the problems related to visual impairment (surgery, refraction devices, etc.).

Globally, 80% of all visual impairment can be prevented or cured. Areas of progress over the last 20 years include: governments established national programmes and regulations to prevent and control visual impairment; eye care services increasingly available and progressively integrated into primary and secondary health care systems, with a focus on the provision of services that are high quality, available and affordable; campaigns to educate about visual function importance and raise awareness, including school-based education; and stronger government leadership on international partnerships, with increasing engagement of the private sector.

Data over the last 20 years shows that there has been significant progress in preventing and curing visual impairment in many countries. Furthermore, the massive reduction in onchocerciasis- and trachoma-related blindness is part of a significant reduction in the disease distribution and has substantially reduced the burden resulting from these infectious diseases. This has been achieved through a number of successful international public-private partnerships.

Brazil which in the last decade has been providing eye care services through the national social security system; Morocoo which has launched a public effort to control glaucoma; China which has invested over 100 million dollars in cataract surgeries since 2009; Oman has completely integrated eye care service provision in the primary health care framework over the last decade; and India since 1995 has made available funds for eye care service provision for the poorest at district level.

The largest civil society effort to prevent and cure blinding disease and rehabilitate people whose irreversibly visually impaired or blind is the SightFirst programme of the International Association of the Lions Club (LIONS). Among others, this programme supports the largest initiative to develop child eye care centres (45 national reference paediatric centres established in 35 countries so far), implemented in partnership with WHO.

WHO coordinates the international efforts to reduce visual impairments. It's role is to: monitor the worldwide trends of visual impairment by country and by region; develop policies and strategies to prevent blindness appropriate for various development settings; to give technical assistance to Member States and partners; to plan, monitor and evaluate programmes; and to coordinate effective international partnerships in support of national efforts.

In 2013, the World Health Assembly approved the 2014-19 Action Plan for the universal access to eye health, a roadmap for Member States, WHO Secretariat and international partners with the aim of achieving a measurable reduction of 25% of avoidable visual impairments by 2019.

WHO works to strengthen national and country-level efforts to eliminate avoidable blindness, help national health care providers treat eye diseases, expand access to eye health services, and increase rehabilitation for people with residual visual impairment or who are blind. Building accessible and comprehensive health systems is the focus of this decade.

WHO leads several international alliances of governments, private sector and civil society organizations aiming at contributing to the elimination of blinding diseases. It

also provides technical leadership to specific disease efforts which are deployed by its partners or the private sector to eliminate trachoma from the world by the year 2020.

For the last two decades WHO has worked with a network of international partners and private sector to ensure that appropriate, updated, good quality eye care solutions were made available to the people in need.

Since 2004, WHO in partnership with Lions Clubs International has established a global network of 45 childhood blindness centres in 35 countries for the preservation, restoration or rehabilitation of sight in children. This unique and innovative global project has served so far more than 150 million children and will open 10 additional eye care service centres for the children in 10 new countries in 2014. The centres will help combat to fight avoidable childhood blindness and help securing a future with full visual function for the children in need of care.

In response to the increasing burden of chronic eye disease WHO is coordinating a global research effort to map services and policies for controlling diabetic retinopathy, glaucoma, age-related macular degeneration and refractive errors.

Finally, to support comprehensive eye care systems, WHO continues to provide epidemiologic and public health technical support to its Member States.

2.1.11 Statistics and Factsheet of Disable

- On average, around 10 percent of the world population is disabled and this number is likely to increase in the near future due to various factors, according to the World Health Organization (WHO).
- Eighty percent of persons with disabilities live in developing countries, according to the UN Development Program (UNDP).
- Disability rates are significantly higher among groups with lower educational attainment in the countries of the Organization for Economic Cooperation and Development (OECD), according to the OECD Secretariat. On average, 19 percent of less educated people have disabilities, compared to 11 percent among the better educated.

- The World Bank estimates that 20 percent of the world's poorest people have some form of disability, and tend to be regarded in their own communities as the most disadvantaged.
- Ninety percent of children with disabilities in developing countries do not attend school, according to the United Nations Educational, Scientific and Cultural Organization (UNESCO).
- The global literacy rate for adults with disabilities is as low as 3 percent, and 1 percent for women with disabilities, according to a 1998 UNDP study. Despite these challenges, ICT and AT have the potential to make significant improvements to the lives of blinds, promoting equality and fostering the development of the blind. Including these students in the use of ICT and AT improves their social skills, learning and ultimately their employment opportunities, by providing the best education possible, building their capacities and developing important life skills.

2.1.12 Understanding the Concept of Visual Impairment

The sense of sight is one of the five senses that humans rely on in their daily activities. Avoke point out that ñthe human eye is one of the important senses that is responsible for the greatest amount of sensory input in manò. Barraga also argues that vision provides about 80% of what humans learn and contributes to incidental learning which visually impaired persons lack; this then has a significant impact on their academic achievement. Even though all the senses are important and support each other to ensure holistic functioning of the individual, I argue that a loss of one especially the sense of sight can have serious consequences on the educational pursuit of the individual. Vision therefore serves as the stabiliser, coordinator and the integrator of the activities of other senses.

In a study by Befring and Tangen, they noted that we live in a visual world where much of the information of todayôs technology is acquired through the sense of sight. This then implies that educational implications of good vision are tremendous and cannot be under estimated. Sharing similar sentiments underscored the importance of the eye when he mentioned that, the eye can be seen as one of the more important senses on which humans place greater reliance when learning as compared to the

other senses combined. Ultimately, the sense of sight plays an influential role in the educational pursuit of the individual. Each visually impaired child who enters an inclusive school presents new challenges and should be considered as unique individual with unique educational needs in the whole school community.

2.1.13. The Rise of Information Divide

Technological innovations have the capacity to transform the destiny of societies by influencing societal processes and stimulating cultural changes. Until recently, print-based media represented the principal form for the storage, display and communication of text-based information. Increasingly, computers have assumed this role and have replaced many previously conventional means of communication. For the past two decades, the capabilities of ICT have expanded exponentially in their range of applications and their future capabilities: they are shaping the world in to a new era of efficient, pluralistic information production. Information Technology is becoming the global tool for a multitude of applications and transactions, from the economic to the academic. In The Rise of the Network Society, Manuel Castells describes this process as "informationalization": the production of information is comparable to the production of material goods during industrialization. According to this historical analogy, computers are the factories of information as a result, a great deal of the present day economic, social, and cultural realities and future prospects of nation-states is determined by the level of I.T. development within them.

The range of application makes I.T. a potentially liberating force; however, as the I.T. industry reflects broader economic, social and political realities, I.T. is often an exclusionary and repressive force. Castells postulates that "informationalization," as the contemporary manifestation of capitalism, divides societies into information "haves" and information "have-nots;" it creates an information divide. He proposes that the "rise of informationalism in this end of millennium is intertwined with rising inequality and social exclusion throughout the world," documenting how "informational capitalism," results in a "sharp divide between valuable and non-valuable people and locales". The world in the era of informationalization has developed new rules of social stratification, rules that cause "technological stratification." Informationalization threatens to create new chasms in society that

reflect economic, societal and technological inequalities. This process carries particularly detrimental consequences for visually disabled people and their capacity to participate in and contribute to a visually dominated, technologically advanced society [32].

For much of the past decade, policy leaders and social scientists have demonstrated increased concern about the growing divide between those with and without access to computers and the Internet. The U.S. National Telecommunications and Information Administration coined the term "digital divide" for this situation in the mid-1990s. Usage of the phrase and debate of the concept soon became commonplace across the globe, describing the stratification caused by the comparative surplus and dearth of information technology in relation to economic and technological means.

The digital divide represents an important initial framework for understanding and raising awareness of the stratifying potential of informationalization. However, it demands greater specificity and sensitivity to address the complexities of information access for visually disabled people. While the entry of the term "digital divide" into popular use and public discourse has raised awareness of the inequalities associated with technological development, the conceptual understanding of the digital divide is narrow. That there is informational and technological stratification in society is undeniable, yet the lines along which these points of exclusion are drawn remain unclear.

2.1.14 Rethinking the Digital Divide

The conventional digital divide paradigm infers that the very presence or absence of computers, in other words the resources to access I.T., is responsible for inequities of information access. While this model wields some explanatory power there is greater access to technology in richer countries than in developing countries this divide is narrow in scope and drawn solely along technological lines. An understanding of the digital divide that ignores economic, political, cultural, and educational issues, as well as diversity concerns and conditions that facilitate optimal usage of I.T, is incomplete and inchoate.

Warschauer reexamines the concept of the digital divide. He "demystifies" the mechanistic model of technological determinism, proposes an alternative model of "social informatics," and calls for the consideration of infrastructural, social and cultural factors in digital divide discourse. This perspective stresses that technology and society are intertwined and co-constitutive, and that it is wrong to assume singular causality while understanding the digital divide). The digital divide is complex and reflects diverse and overlapping patterns of digital inclusion and exclusion that exist within and across nation states and are defined according to political, economic, and sociological factors. Because of the intricate relationship between these factors, increased physical access to gadgets alone fails to bridge this gap.

The digital divide in its broadest sense implies a chain of causality ð both means and the ends of social stratification, and not a linear process. The lack of access to computers and the Internet affects many aspects of everyday life, but societal factors also determine the categories of "info rich" and "info poor." Although the possible range and efficacy of I.T. application makes it a potentially liberating force, those who are already marginalized from society are less likely to gain access to technology, and are more likely to be pushed to the technological as well as the societal periphery. In this way, the information divide reflects pre-existing societal inequalities and contributes to the further marginalization of minority groups in society.

Disability produces an invisible minority that is socially, culturally, and economically marginalized. This minority group that has existed on the societal fringe- ostracized from the development process is now excluded from the realm of information technology. Visually disabled people are arguably the marginalized group most drastically affected by the information technology industry because of the visual bias of so many ICT products. The idea of two distinct poles ð the technology "haves" and "have nots" ð dilutes the complex reality of digital divide that surrounds visual disability because mere technology does not ensure equitable access to information. Thus, informationalization, as a force of marginalization, pronounces and exacerbates inequalities and barriers faced by visually disabled people: the phenomena described by Goggin and Newell as "digital disability."

The concepts of "social informatics" and "digital disability" illustrate clear shortcomings in the conceptualization of the digital divide. We believe that these ideas, combined with a cross-cultural understanding and personal experience of the barriers faced by visually disabled people, pronounce the inadequacies of the digital divide as an explanatory paradigm. Therefore, the barriers to information access and issues surrounding I.T. must be defined in terms of the relationship between disability, technology and society. The visual bias of digital technologies, which arguably affects visually disabled people more than any other marginalized group, reflects the attitudinal, infrastructural and institutional biases of society at large. Therefore, it is imperative to understand the interplay of visual disability, digital technology, political economy and the culture.

2.1.15 Disability Today

A permanent disability, as viewed by the Australian Bureau of Statistics (2003a), is an impairment that is likely to last, or has lasted, in excess of six months. In Australia, approximately four million people, or 20% of the population, have some form of permanent disability and this percentage has steadily increased in recent years (Australian Bureau of Statistics, 2003a). Other Western countries have a similar situation. In the United States of America (USA), approximately 19% of the population have some form of permanent disability (United States Census Bureau, 2000) and in the European Union (EU), approximately one in six people of working age have some form of permanent disability (European Agency for Safety and Health at Work, 2002). The prevalence of disability is not only of concern for Western governments but also a highly important global issue. According to the World Health Organization (WHO), there are approximately 600 million people in the world with some form of disability, approximately 10% of the worldôs population.

Initially, it would seem that the statistics suggest Western cultures have a substantially higher rate of people with disabilities in comparison to the world average. Whilst it is possible that factors such as a longer life expectancy has increased the disability rates in Western countries, it remains difficult to establish this as fact. Despite the importance of being able to view statistically disability-related issues on a global scale, there is surprisingly little data to allow for a statistical comparison between different countries. This situation is due to different measuring standards including age groupings, the selection of disabilities to be used in the statistics, the impact of the aging population in an overall statistical analysis and the time period in which a disability is defined as permanent. To address these irregularities, the United Nations Statistics Division initiated a system in 2005 that will provide a systematic and regular collection of basic statistics on human functioning and disability [31].

However, statistical anomalies between countries do not hide the significance and prevalence of people with disabilities in both global and local terms. Even such limited statistical information demonstrates the sheer number of people affected by disability. It also demonstrates disability-related problems such as unemployment and exclusion from education and poverty. It is estimated that approximately 80% of people with disabilities live in poverty and find it difficult to meet their needs for food, shelter and rehabilitation. Such data emphasis that people with disabilities are some of the most disadvantaged in society. Although it is difficult to implement a global data analysis of disability, virtually all reports on disability welfare acknowledge that there is a clear linkage between poverty and disability. The impact of poverty is twofold: currently, poverty can cause disability through, for example, poor health care and secondly, a person with a disability is more likely to struggle with poverty since, without support and assistance, the individual is prevented from leading a productive life [31].

In Africa, issues of educational disadvantage, unemployment and poverty are equally relevant. In terms of education, approximately 30% of people with disabilities aged between 15 and 64 have completed schooling to Year 12 and 13% have completed a bachelor degree or higher. This is notably different to the total population whose educational rates are 49% and 20% respectively. In terms of employment, there are

again significant differences. People with disabilities achieve an employment rate of 53% and have an unemployment rate of 8.6%, as opposed to 81% and 5% respectively for the able-bodied population. Personal income for people with disabilities on average is approximately half that for an able-bodied income earner. People with disabilities are further disadvantaged in that the removal of one or more essential life skills can dramatically reduce the opportunities for education and employment (Australian Bureau of Statistics, 2003a). The connection of disability with unemployment AND a lack of education and poverty were highlighted in a Senate committee into poverty in Australia. It was noted that poverty was particularly prevalent in Australia amongst people with disabilities due to a combination of factors including low incomes, fewer employment opportunities or additional costs due to their disability [31].

These statistical data regarding people with disabilities provide an important overview of the welfare of people with disabilities. However, facts and figures reveal only a snapshot of current conditions and do not explain how people with disabilities experience their disadvantage in our society. In order to explore this issue, it is necessary to understand the way society perceived, and currently perceives, people with disabilities. It is also important to understand the way in which people with disabilities perceived, and currently perceive, themselves. It is to this question of social perception that I now turn.

2.1.16 Policy approaches for people with disabilities

The models within which society as a whole views and constructs people with disabilities are, by themselves, largely without particular force or effect in the everyday lives of such people. However, these models have, and continue, to underpin the development of policy which in turn takes real substance in legislation that affects the interactions of people with disabilities and the rest of society. Policy and legislation, therefore, give effect to the models just described and in turn reinforce or change their dominance in society.

Bourk likens policy making to a cultural evolution, in that the dynamic nature of a culture results in the creation of policy that grows or evolves. This indicates the close relationship between the views of society and the formation of policy; should

policy not reflect the views of society, it becomes culturally redundant. In essence, policy cannot stand still because the views in society on which policy is based cannot stand still [30].

In terms of disability-specific policy, there is also a close relationship between the changing social categories and the rapidly changing ideological, theological and cultural factors considered in the formation of legislative frameworks. Drake identified five such ideological categories for creating policy and legislation for people with disabilities. These ideological stances are as follows: negative, laissez-faire, piecemeal, maximal and social rights-based [28].

The negative ideological stance involves actions by the state that actively deny the civil rights of people with disabilities. A link can be seen with the charity model, in which people with disabilities are to be pitied and are believed to require assistance, precisely because they are not like other ónormalô people. Viewing people in terms of their tragic circumstances, as with the charity model, places individuals in a situation where they are always seen in a negative context and denied the right to live independently within society. As a result, negative policies are most likely to be adopted during a time when the charity model dominates social constructions of disability. In large measure, policies in the contemporary era are not characterised by a negative ideology.

The laissez-faire ideological stance focuses on absenting the state from intervention in social order so as to better meet the needs of people with disabilities. This stance is closely tied to the emerging free-market economic model, where the market rather than government determines the way in which society caters for people with disabilities. Although it is rare for the state to be completely removed from the role of people with disabilities, governments that actively encourage private industry to cater for people with disabilities can lead to the economic model becoming dominant, both implementing laissez-faire-based polices and further reinforcing this ideological stance. For example, the Canadian Federal government used this stance in the mid-1990s by actively campaigning for private industry to employ people with disabilities. Although this approach initially involved significant involvement from the government, it resulted in a reduction of disability-related government services due to

the increased support of the corporate sector (Canadian Department of Human Resources and Skills Development, 1999). Similar developments are currently taking place in Australia with changes to welfare provisions for people with disabilities [29].

The piecemeal or disorganised ideological stance occurs when the state takes some responsibility, but in an ad-hoc or hazardous way. This model is associated more with a changing of social categories rather than a specific social category. Changing social constructions of disability - for example the increased recognition of the rights of people with disabilities - effectively place governments in a position where they must develop and implement new policies. This policy development can often occur in an uncoordinated manner as several different perspectives on what is best to be done for people with disabilities come into conflict; from such incoordination, hazards can result for people with disabilities, particularly where insufficient time and research has been devoted to formulating effective policies to assist such people and the changes are, instead, carried through in a shallow and speedy response to apparent changes in social need. Essentially, such policy developments reflect the stateôs lack of consistent engagement with people with disabilities. While this ideological stance rests on the assumption of state responsibility for people with disabilities, it also reflects the very low priority accorded to this responsibility

Maximal policy endeavours to actively identify and resolve disadvantages caused by an individualôs disability but with minimal consultation. It is strongly centered on the role of the state but in a relationship that silences the voices of people with disabilities in favour of the implementation of policy developments based on scientific or medical advice. Maximal policy is therefore closely linked to the medical model in that it constructs people with disabilities as inferior individuals who need to be cared for by the government in safe environments such as sheltered workshops without actually treating such people as capable of full independence. Thus, while reflecting greater care, a maximal policy ideology serves to severely limit the potential for independence by removing rights from the individual and giving them to the state to ensure that they are seen to be productive members of society (Drake, 1999).

In Western culture, specific policies and practice differ between countries. However, they are largely based on a social rights-based ideology in which the state views its responsibility to assist all citizens, including people with disabilities, and takes special care for those whose rights might be threatened or challenged by differences from perceived ónormsô. This policy stance reflects the rights model previously discussed; it is designed to ensure equal support to all groups and supports the independence of people with disabilities which can result from such policy. The potential detriment of such a policy for people with disabilities is that ñé disablement is a product of society and environment designed by non-disabled people for non-disabled peopleò. Although policy directions such as this are highly beneficial to people with disabilities, governments must constantly endeavor to anticipate and meet the needs of people with disabilities to ensure equality in society.

In essence, the decision-making process regarding disability-related policy and legislation is largely based on the social construction of disability. The different social categories, viewed as models, are closely related to the different ideological stances used in the development of policy. As society changes, the ideology behind policy creation also changes.

2.1.17 Examples of disability-related policy and legislation development in western countries

As previously demonstrated, the way society views people with disabilities is, in a general sense, constructed by the internal logic and assumptions of ómodelsô of disability, one of which tends to be dominant in a particular society at a particular time. Policy and resulting legislation flows from that model, giving effect to one or other particular ideological stance that determines the overall relationship of the state to people with disabilities. Each of the ideological stances outlined tends to reflect one of the models.

An example of the relationship between policy and models was demonstrated in the 1950s when most Western countries did not have any clearly defined policy for people with disabilities. Sainsbury indicated that ñin Britain, no attempt has been made to respond systematically to the problems of the disabled population.ò The reason for this lack of policy was due to a combination of piecemeal and negative

policy approaches in that the government did not have any active policy and it was seen to be the role of charities to look after people with disabilities, reinforcing the association of disability with tragedy and loss [27].

The effective implementation of maximal policy occurred in the late 1960s and early 1970s, while rights-based policies and legislation began to emerge in the mid-1970s in most Western countries [26]. An example which highlights the use of maximal policy and the move towards the use of rights-based policies was the introduction of sheltered workshops in Britain (Schlesinger & Whelan, 1979). The introduction of sheltered workshops by the government ensured a high level of government intervention in the lives of people with disabilities. However, a change in policy was sparked by a number of studies. One significant example is the 1979 British study into the validity of sheltered workshops. Although this study revealed that the government had succeeded in providing economic benefits to the country through the use of laissez-faire and maximal-based policies, the report noted that ñthe majority of those attending the Centres will probably work there permanently because they will never reach outside employmentò (Schlesinger & Whelan, 1979, p104). This was a large blow to existing policy as it was initially believed that getting people with disabilities into sheltered workshops was a valid and responsible way of social integration.

2.2. The Digital Divide for Visually Impaired In Nigeria

Within contemporary Nigerian society, there is little appreciation that disability is fundamentally an issue inexorably link to and rooted in human rights. The common perception, held by policy-makers and the public at large, is that disabled people and disability issues are viewed in terms of charity and welfare. Consequently, this viewpoint is a significant, entrenched factor that seriously militates against the social inclusion of disabled people within the country, Raymond & Lucy [6]. Hence, the non-inclusion and ostracizing of people with disability, including, the blind and visually impaired.

About 4.25 million adults aged less than or equal to 40 years in Nigeria have moderate or severe visual impairment or blindness [7]. This number, over 1 million adults are blind while the remaining 3 million are with moderate to severe visual impairment. Corroborated this statistics by stating that ñIn Nigeria, over 1,000,000 adults are blind and another 3,000,000 are visually impaired, 42 out of every 1000 adults aged 40 and above are blindò [8],. In their work, concluded that ñthere is a high prevalence of blindness and severe visual impairment among those aged less than or equal to 40 years in Nigeria [9]. Significant differences exist between the geopolitical zones and emphasis should be on ensuring eye services across Nigeria, which means that planning at the regional level is necessary.

2.2.1 The Concept Of Assistive Technology

Assistive technology can be seen as any item, equipment, or product, acquire, modified, or customized, that is used to increase, maintain, or improve functional capabilities of people with visual, audio, mental, or physical disability.

Technology has removed many barriers to education and employment for visually impaired individuals. Students with visual impairments can complete homework, do research, take tests, and read books along with their sighted classmates, thanks to advances in technology. Adults with visual impairments can continue to work and pursue a tremendous range of careers because of the use of computers and other devices.

A wide range of assistive technologies for people with visual impairments exist for users at all stages of sight loss. These include: Screen readers, Screen magnifiers, Speech recognition software, Text-to-speech (TTS) software, Optical character recognition (OCR) software, Large monitors, Closed circuit television (CCTV), Hand held electronic magnifiers, Dictation devices and transcription, Scanners, Standalone reading machines, Fusers and swell paper, Braille technology, Refreshable braille displays, Braille notetakers, Braille embossers, Braille writers, Braille translation software, Alternative keyboards, Audio description, Audio players, and Digital books.

2.3. Information and Communication Technology (ICT) and Assistive Technologies (AT)

IT was opined that ñInformation is an integral part of all human activity, and Information Technology (IT) carries the power to shape if not determine our individual and collective lives [10]. Preliminary analysis of the impact of information technologies suggests that the information revolution creates a divide ð the "digital divide" ð between those with and without access to information technologyò. According to UNESCO [11] ñInformation and Communication Technologies (ICT) are recognized as a key driving force in virtually all initiatives that rely on knowledge-based and skills-oriented development activities in all spheres of human endeavor. There is also growing recognition that, if equipped with the necessary adaptive and assistive technologies, persons with disabilities can perform equally well in the classroom and workplaceò

Chaudhry and Shipp opined that, ñthe advent of voice-aided assistive information technology (AIT) represents a significant technological development carrying the potential to narrow the digital divide for visually disabled people. Information access ð via screen-reading computer software that reads on-screen text through a voice synthesizer ð has increased the availability of digital information for visually disabled peopleò.

ICT has revolutionized the way Assistive Technology (AT) are being developed to assist the blind and visually impaired. It was stated that ñNew technology to help blind people text using touchscreen mobile devices are been developed. Researchers at Georgia Tech produced the applications, based on the Braille writing system [12]ò. It is claimed typing with the app is up to six times faster than existing methods for texting without sight. Access to assistive technology for the visually-impaired is a growing issue due to the proliferation of touchscreens.

The Adaptive Technology Center for New Jersey Colleges, developed a number of assistive technology system for different categories of visual impairments, most of which are based on ICT [13]. They include but not limited to: Screen Magnification, Screen Readers, Scan/Read Systems, Portable Notetakers, Video Magnifiers, and

Digital Book Readers. Each of these technologies is relevant for different levels of visual impairments.

Accordingly, ôinformation resources for people with disabilitiesô promulgated a list of 8 top free web browsers assistive technology for the visual impairment [14]. These are a variety of disability software, all of it free, which allows users to hear text on their computer. Some of it was created specifically to work with Firefox, another requires Windows, but all of it designed to make your life easier for the visually impaired while browsing the internet. The browsing software as outlined below are:

1. **WebbIE**

With a proven track record since 2001 and world-wide use, WebbIE comes with a suite of accessible programs. You can hear news and audio on the internet, enabling you to listen to podcasts, access RSS and more with your screen reader.

2. **EdWeb**

It may take a little extra effort to get EdWeb set up just how you like, but youôll be glad you took the time! Thereôs a comprehensive manual to help you download full symbol support and text-to-speech (tts)/talking buttons. Choose to access it with a mouse, touch screen, mouse emulator, Grid Editor (another free download), or switch scanning. This disability software operates on Windows 98-XP and later. Combine it with the free EdWord symbol/talking word processor and link your symbol set or create grids.

3. **Fire Vox**

Featuring a mouse-driven interface, this extension for the Firefox web browser is like a screen reader with more than the usual basic features. Sure, Fire Vox identifies headings, links, and images for navigational assistance, but it also supports MathML and the CSS speech module. Better yet, it works on Windows, Macintosh and Linux.

4. **Fire Vox** is one component of the Core Library Components for Text-To-Speech. The suite is comprised of three extensions, including Fire Vox, a core library for test-to-speech synthesis, and a utilities library for navigating the HTML DOM.

5. **CliCk, Speak**

Unlike its cousin Fire Vox, above, which was designed with blind and visually impaired users in mind, CLiCk, Speak caters to sighted users who want text-to-speech capability. It neither identifies elements nor informs you of events, two functions essential to visually impaired users but merely irritating to sighted users. If you are

sighted but have cognitive disabilities (dyslexia, MS, etc.) that are mitigated by listening to, rather than reading, web content, then CLiCk, Speak is the extension for you. The system features an easy, mouse-driven interface that is a snap for users accustomed to point-and-click graphic interfaces. Like Fire Vox, it also works on Windows, Macintosh and Linux. Additionally, CLiCk, Speakôs multilingual support makes it ideal for practicing a foreign language.

6. **Orca**

The Orca browser is fast, friendly and ready to help: more like a greyhound than a killer whale! The browser itself features security, low memory consumption, a spell-checker, built-in download manager and more, but it also trumpets an AD blocker, flash blocker, online profile storage, automated form filler, and an RSS reader. With a username and password, the above features let users access information such as personal bookmarks, autofills and RSS feed remotely from any computer.

7. **Simply Web 2000**

If you prefer using Internet Explorer and want a speech-friendly, speech-enabled accessible browser with easy navigation for visually impaired users, then check out Simply Web 2000. The software-based speech synthesizer included in the package can be used as a talking web browser in standalone mode.

8. **SpeakOn**

A single keystroke will get you downloads of media on demand for audio and text alike, whether youôre working in Media Centre, Radio Time or VI Services applications. Plus, it implements with Seeing Ear library books and eText, as well as TNAUK publications, which can be converted automatically to HTML format to use with your cell or an external player.

9. **Thunder**

This award-winning screen reader hails from across the pond, and the Brits have done a nice job. With features suited for people who are blind and visually impaired, Thunder can become your radio, library and mailbox. One fan even claims her talking computer is now her best friend! And whatôs really cool if you secretly have monarch envy? HRH the Duke of York is a patron.

2.3.1 Modes of Information Access By Visually Disabled People

Conceptualizing and understanding how visually disabled people process data and information during their daily lives is crucial to reexamining the concept of digital divide in terms of visual disability. Visually disabled people access information and construct meanings through the non-visual senses: smell, touch, taste and, primarily, sound. We propose that people with visual disabilities perceive and access information in two broad forms: "informal" and "formal." This categorization distinguishes between different forms of information and the processes employed by visually disabled people to access information. Furthermore, this classification provides useful insights for understanding "information access" from a cross-cultural perspective.

"Informal" refers to sensory information or data from the immediate surroundings or physical and social spaces. In everyday life, a general perception of the physical environment is required to navigate spaces and places. Maneuvering through visually-orientated spaces, for example, a domestic area such as the kitchen, or public spaces such as roads, requires the utilization of "informal" information. Visually disabled people mainly access informal information with the help of human support provided by family, friends, community members, and other informal networks. In other words, visually disabled people mediate visual images and access their physical and spatial surroundings through social capital ð the networks, norms and trust that facilitate cooperation and support for mutual benefit. Social capital is rooted in the cultural norms pertaining to these social support mechanisms and embedded in the notion of community itself [15].

"Formal" information describes encoded data that requires educational or technological competencies to decode, and, therefore, to make sense of. Text is a commonly encountered type of formal data, requiring knowledge of a sign system and educational capital to interpret and discern. More often than not, "formal" information is visually formatted and thereby exclusionary to people without vision. Of course, Braille is an alternative system of encoding and decoding "formal" information that presents data in a form accessible to tactile senses. However, the increase of electronic "Formal" information, which is increasingly generated and disseminated through ICT, has effectively rendered Braille redundant. The development of assistive information technologies and other voice-aided devices that access formal electronic

information has increased correspondingly. Since information and communication technology employs "formal" information in a primarily visual text format, it presents rapidly evolving obstacles to access for visually disabled people. Though AIT facilitates access to formal electronic information, the rapid progress of informationalization erects new barriers, creating an information divide for visually disabled people that exists in similar and divergent forms across different nation-states and cultures.

The evolution of the International Classification of Impairment, Disability and Handicap.

One of the most significant contributions to rights-based disability policy and legislation was the development of the International Classification of Impairment, Disability and Handicap (ICIDH). The current dominance of rights-based policy and legislation depended, and continues to depend greatly, on a clear system of disability terminology. Western governments have acknowledged that, in relation to legislation, ñthe importance of definitions has become greater as access to significant services depends upon such definitionsò. The framework which provides the definitions used in most worldwide disability-related policy are the definitions created by the World Health Organization (WHO).

World attention towards the needs of both people with disabilities and policies regarding people with disabilities was attracted by the WHO in 1976 when it released a preliminary set of key definitions of disability terminology. These definitions were refined and formally released to the international community in 1980.

IMPAIRMENT: In the context of health experience, an impairment is any loss or abnormality of psychological, physiological or anatomical structure or function.

DISABILITY: In the context of health experience, a disability is any restriction or lack (resulting from an impairment) of ability to perform activity in the manner or within the range considered normal for a human being.

HANDICAP: In the context of health experience, a handicap is a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents

the fulfilment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual.

Impairment refers to a psychological or physiological condition; disability is a restriction as a result of that condition and a handicap is a restriction placed on an individual by society. These definitions were promoted by the WHO as part of the

United Nations (UN) during the International Year of Disabled Persons in 1981. The establishment of these definitions provided a welcome resolution to the issue of terminology and they became the basis for disability-related legislative policy throughout the world.

2.3.2 Conclusion

This chapter clearly establishes that there is a strong link between the social construction of disability, policy ideologies, the creation of disability-specific policy and the impact of such policy on people who are blind or vision impaired. The exploration of disability in its social and historical context allows society to see that it is not a fixed concept but one that will always change with the attitudes of society. People with disabilities are significantly affected by such changes, reflected by the dominant model which gives expression to the social construction of disability. These effects can be negative, as represented by the perception of tragedy or loss in the charity model or the perception of inferiority as represented by the medical model. In contrast, the rights-based model and, to some extent, the market-driven economic model, can result in people with disabilities being treated in a positive manner, striving for equality and value. Both people with disabilities and able-bodied people alike have the opportunity to influence attitudes and, as such, perceptions will continue to change. Policy and legislation both reflect and contribute to the social construction of disability. Where the dominant social category is based on the charity model, policy approaches are generally negative. In addition, when the medical model features as the dominant social category, the maximal policy approach is more likely to be adopted. Currently, in most Western countries, the domination of rights-based and economic model social categories are reflected by rights-based and laissez-faire approaches to policy and legislative changes.

The creation of the definitions of impairment, disability and handicap are further evidence of how changes in society can directly affect the creation of policy. People who are blind or vision impaired, as with other disability groups, are in turn significantly affected by the implementation of such policy which can contribute to further changes in society. However, people with vision disabilities face additional barriers in relation to learning, mobility and access to visual information. The fear of blindness within society also creates attitudinal barriers by reinforcing the view that such a disability can be restrictive when interacting in society. Essentially, this chapter identifies that society and policy and is key factors in affecting the welfare of people who are blind or vision impaired.

During the period of rapid social change, another significant movement was occurring: the evolution of computing and Internet technologies. For people with disabilities, the delivery of evolving technologies not only delivered new products and services but also delivered the hope of equality and independence. The following chapter explores the role of computing and the Internet and its impact on the welfare of people who are blind or vision impaired.

CHAPTER THREE

RESEARCH METHODOLOGY, SYSTEM ANALYSIS AND DESIGN

3.0. Introduction

This chapter shows the methodology followed to achieve the aim and objectives of the research, offers explanation as to the research methodology and the data collection techniques employed with respect to this project. A multifaceted approach is required to effectively carry out an inclusive assessment of the ICT support services available to assist the blind and visually impaired to bridge the digital divide in Nigeria. Both primary and secondary data would be used for this study. The secondary data would largely be a critical review the assistive technologies specifically designed to bridge the digital divide for the blind and visually impaired; both globally available assistive technologies and the locally available assistive technologies would be reviewed. The primary data would be collected by structured questionnaires as research instrument to assess the level of awareness and adoption of the assistive technology by the blind and visually impaired. Responses from the questionnaires would also help to identify major challenges facing the blind and visually impaired with respect to harnessing the ICT support services. Then ICT solutions to the challenges facing the blind and visually impaired would be proffered.

3.1 Sample Selection Procedure

In conducting the research, the use of questionnaires to get information from the respondent was used In addition, because the study relied more on qualitative than quantitative research methods, a case design was ideal.

3.2 The Survey Design

The main survey instrument is a structured closed ended questionnaire. The administration of the questionnaire is almost akin to an individual interview session because most of the respondents are blind or visually impaired. This was done to assist the respondents and to also save time. The survey consists of 5 sections. Section 1 is for the demographic attributes of the respondents, while the other 4 sections are

structured to reflect and provided for each of the 4 objectives of the study. (see appendix i)

3.3 Sampling Technique and Survey Distribution

A sample set of the entire population of the blind and visually impaired was taken for this research, using stratified sampling technique. A total of 310 questionnaires were distributed. 5 each to the 28 schools for the blind across Nigeria, 10 to the blind and visually impaired students of special education in the University of Calabar, 10 random members of the albino foundation and 150 to general blind or visually impaired members of public

3.4. Response to the Survey

Out of the 310 questionnaires sent, only about 162 were received back. This represents about 52 percent of the responses expected. Considering the peculiarity of the sample group, this number can be said to be sufficient for the research.

3.5. Data Analysis and Presentation

Data was analyzed using simple tabulation of computed percentage frequency distribution and presented in graphical chart representations. In most cases, grouping and ranking method was used to disaggregate data.

3.6. Review of existing system /procedure

After finish typing a document, the visually impaired student will just assumed that whatever they type in the document is right. So they went ahead to print the document not minding any mistake the work would have carry, except somebody will have to do the correction for them.

3.7 Problem of the existing system

Problem the visually impaired are going through with the normal typing programs includes:

1. Slow operation in preparing a documents,
2. Much stress on the visually impaired,
3. Inaccuracy typing processing files,
4. Poor documentation,
5. Data redundancy.
6. Very expensive to owned

3.8 System Analysis and Design

3.8.1. Development Environment

Visual Studio 2015 is selected to be used to develop the program. The essence being that the environment contain tools that can aid fast development processes especially its debug related tools. It also allow for multi-window file editing processes which is essential to multi-tasking abilities during development. The IDE (Integrated Development Environment) is actively development, managed and supported by Microsoft Corporation.

3.8.2. Program Selection and Structure

The entire coding of the program was done in visual basis.net. VB.NET was used because it contains libraries related to speech and string manipulations. These codes are written with the front-end tool but, with other tools provided from the .NET framework classes and libraries such as Conversion String, they were able to access the backï end tool. The entire code of the program is contained in the appendix.

The program of this research work was designed in modules, which could be compiled into a single application. Each module is written separately and linked up together and compiled into one single unit called ñSpeechAppò. The program first of all imports all the necessary libraries e.g. system, system.speech, system.window.forms etc. After the importations, two modules in form of classes are

declared and defined. These are the main class and the Splash Screen class. Each module contains different functions/methods/procedures that functions according to what itôs designated to do. The splashscreen module contains functions that relates to the manipulation of the splash screen. That module display the splash screen, computes the time interval between it and the next module to be loaded and loads the next module. The next module (main) has procedures such as ExitButton_MouseHover, btnback_MouseHover, ContinueButton_MouseHover, PauseButton_MouseHover, etc. here is where the programôs procedure to read a typed text is read (ReadTextButton_Click). The program starts from loading, then it proceed to the main menu where option are displayed for selection then when any option of userôs choice is chosen and worked on, the final stage is to exit.

3.8.3. System Flow Chart

See Appendix iii.

3.8.4 Program Flow Chart

See Appendix iv.

3.8.5 Systems Requirements

This application may not run effectively if the minimum system specification is not met therefore, there is need to install a proper system hardware and software required for the application to meet up the objective as stated.

3.8.5.1 Hardware Requirements

Processor	:	Intel Core Duo 2.0 GHz or more
RAM	:	1 GB or More
Hard disk	:	80GB or more
Monitor	:	15ò CRT, or LCD monitor
Keyboard	:	Normal or Multimedia
Mouse	:	Compatible mouse

3.8.5.2 Software Requirements

Operation System	:	Windows 7 +

3.9 Input Specifications

The input specification of this project work is:

1. Keyboard
2. Mouse

The keyboard is use by the screening officer to input the time and day for screening, the mouse is use to click instruction by the students and the officer.

Output Specification

The output is very precise and comprehensive. The output is the speaker that will voice out the converted text. Anything the user type, the speaker will voice it out as a command.

CHAPTER FOUR

PRESENTATION OF FINDINGS AND SYSTEM IMPLEMENTATION

4.1. DEMOGRAPHIC INFORMATION

4.1.1 Gender Distribution

The distribution of the collected questionnaires shows that there were 95 (58.64%) males and 67 (41.36%) females.

4.1.2 Age Distribution

The age group less than 20 among the respondents were 47 (29%), those between 21 to 40 years were 65 (40%) while those above 40 years were (31%).

4.1.3 Educational Status

The educational status of the respondents also varied slightly. Those without any form of formal education were 45 (27.7%), those who had a maximum of primary education were 26(16%), those who completed secondary education were 33 (20.37%) while those who were either in tertiary institutions or have finished tertiary education were 58 (35.92%).

The breakdown of demographic distribution is shown in table 4.1 below, with the corresponding graphic charts representations in figure 4.1, 4.2, & 4.3 respectively

Table 4.1. Demographic Distribution of respondents

	Gender		Age Group			Education			
	Male	Female	<20 years	21-40 years	>40 years	None	primary	Secondary	Tertiary
No vision	34	18	7	14	31	20	5	13	14
Visually impaired	61	49	40	51	19	25	21	20	44
Total	95	67	47	65	50	45	26	33	58
Percentage	58.64	41.36	29	40	31	27.7	16	20.37	35.92
Grand total (%)	162 (100%)		162 (100%)			162 (100%)			

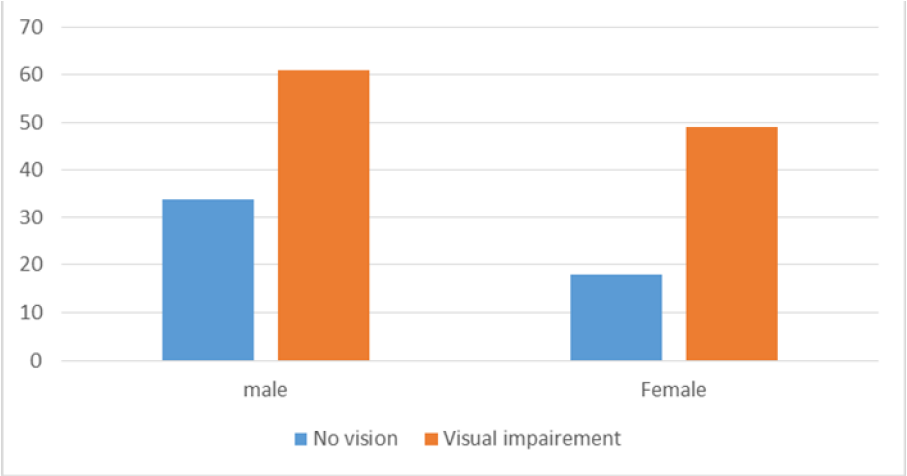


Figure 4.1: Distribution of Blind and visually impaired respondents according to gender.

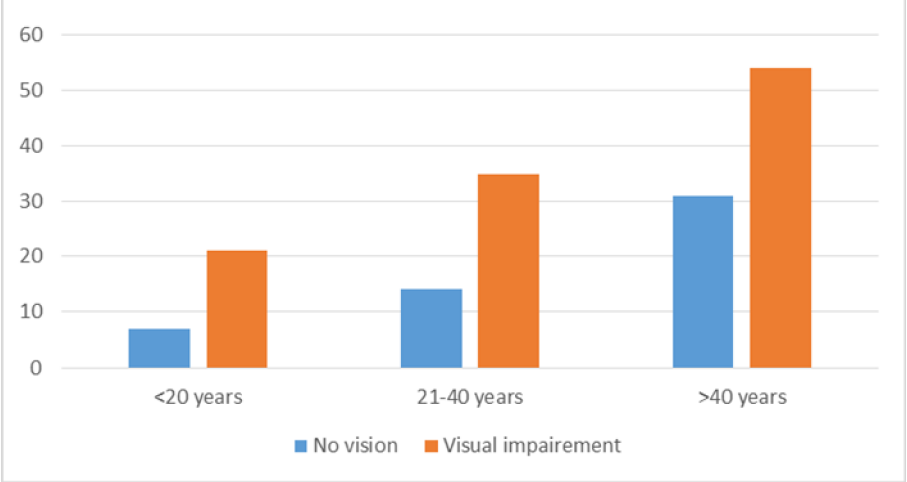


Figure 4.2: Distribution of Blind and visually impaired respondents according to age

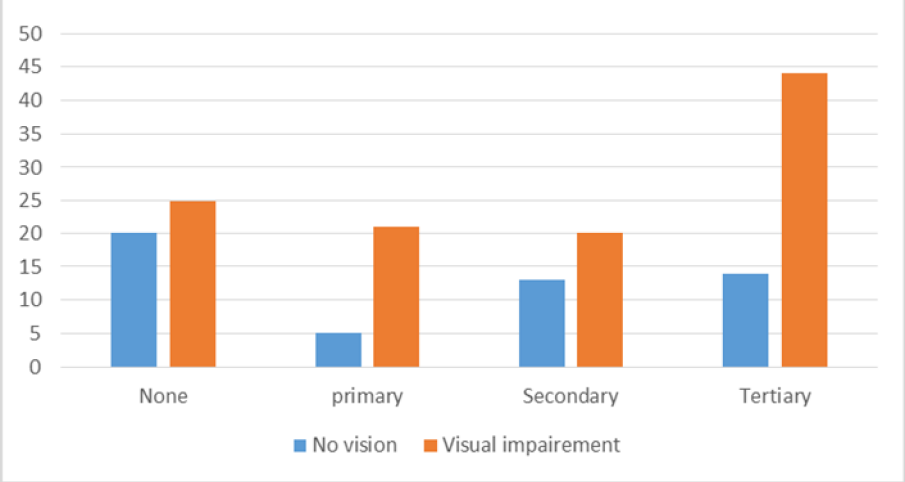


Figure 4.3: Distribution of Blind and visually impaired respondents according to education status

4.2. Assess The Level Of Awareness And Adoption Of The Assistive Technology By The Blind And Visually Impaired.

Analysis of the awareness level and adoption of Assistive Technology vary across different demographic groups. Out of the 162 respondents, 67 (41%) are aware of some form of assistive technologies, while 95 (59%) are not aware of any form of assistive technologies. Table 4.2 and figure 4.4 shows the level of awareness of assistive technology. This shows that a little above half of the respondents are ignorant of assistive technology.

Table 4.2: Respondents Level of Awareness of Assistive Technology

Level of Awareness	Aware	Not Aware
No of respondents	67	95
% of respondents	41	59

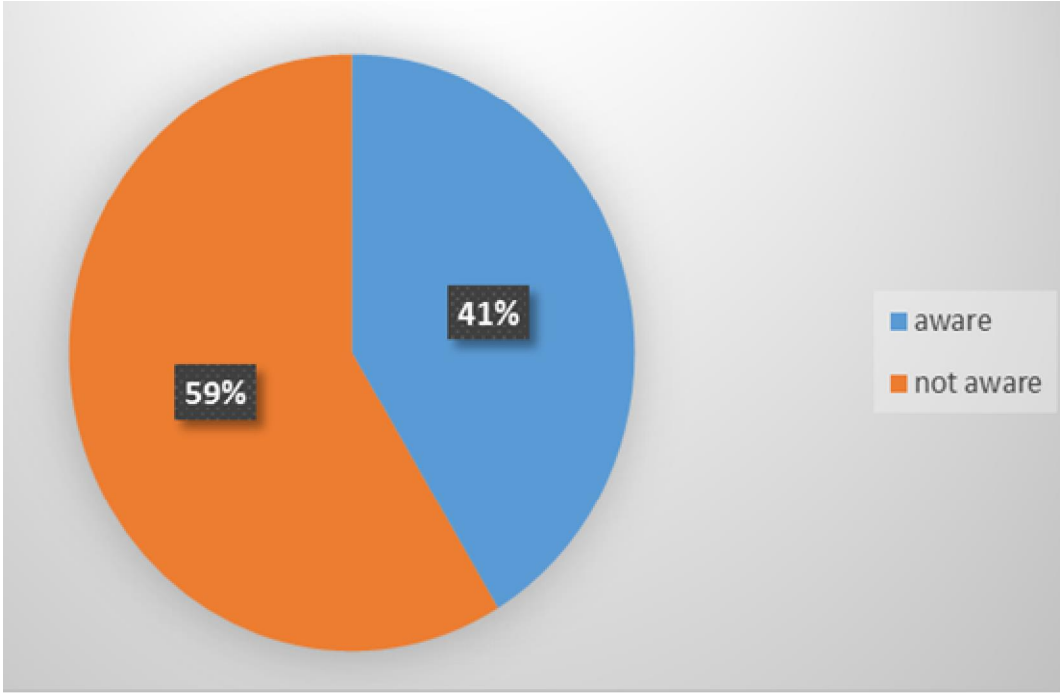


Figure 4.4: Respondents Level of Awareness of Assistive Technology

Out of the 162 respondents, only about 26 respondents, representing 16% have used one form of assistive technology or the other. The remaining 136 respondents representing 84% have not used any form of assistive technology. Table 4.3 and figure 4.5 shows the respondents level of adoption of assistive technology.

Table 4.3: Respondents Level of adoption of Assitive Technology

Level of Adoption	Use	Not Use
No of respondents	26	136
% of respondents	16	84

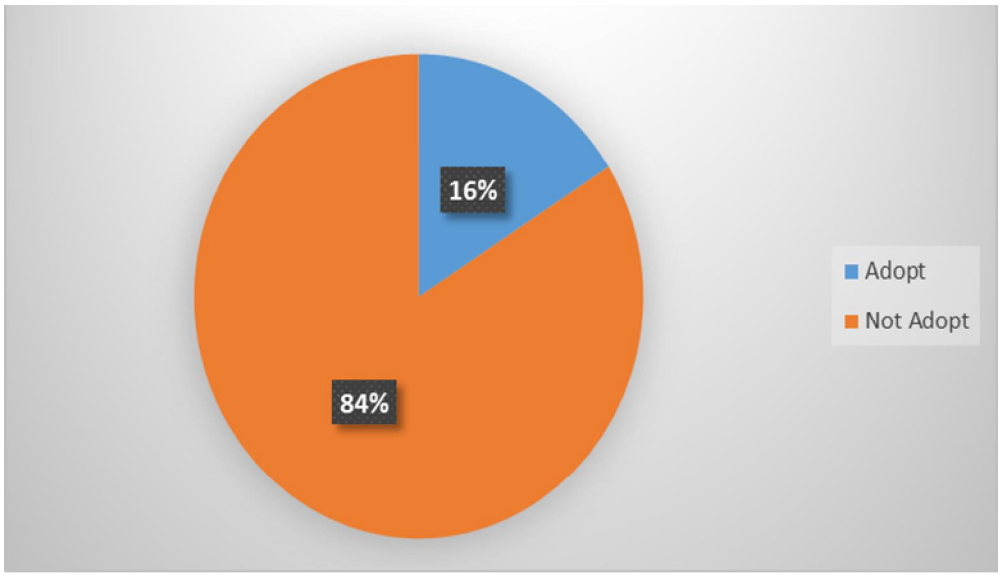


Figure 4.5: Respondents Level of Adoption of Assitive Technology

A breakdown of the awareness and adoption according to the various demographics are as shown in table 4.4 and figures 4.6, 4.7 and 4.8. It is clear from the analysis that the higher the education status of a respondent, the more the likelihood of higher awareness and adoption of assistive technology. Also, male respondents are more prone to a high level of awareness and adoption of assistive technology than female respondents. While those of the age group 21 to 40 years old have a higher tendency for awareness and adoption to assisteve technology than the less than 20 years and the greater than 20 years age groups.

Table 4.4: summary of level of awareness and adoption of assistive technology by demographic attributes.

	Education				Gender		Age Group		
	None	primary	Secondary	Tertiary	male	Female	<20 years	21-40 years	>40 years
Awareness	1	5	20	42	48	19	11	31	25
Adoption	0	2	9	15	18	8	5	14	7

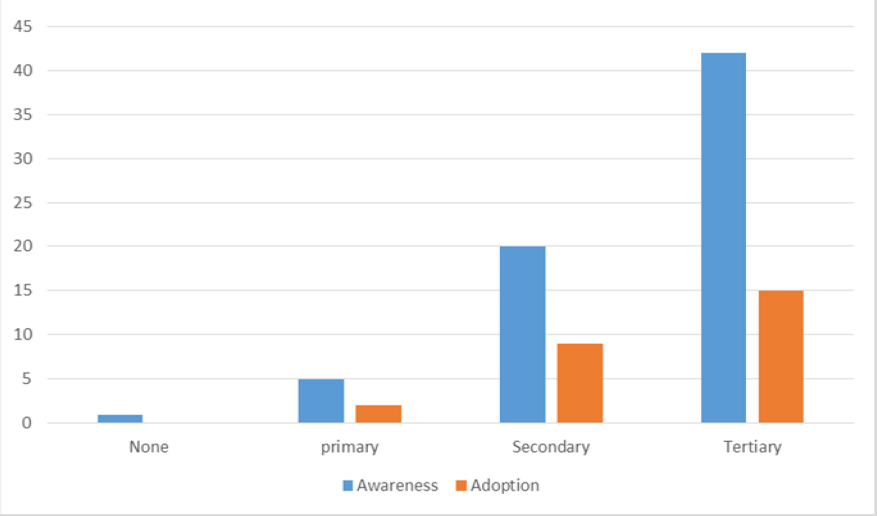


Figure 4.6: Respondenst level of awareness and adoption of assistive technology according to educational status.

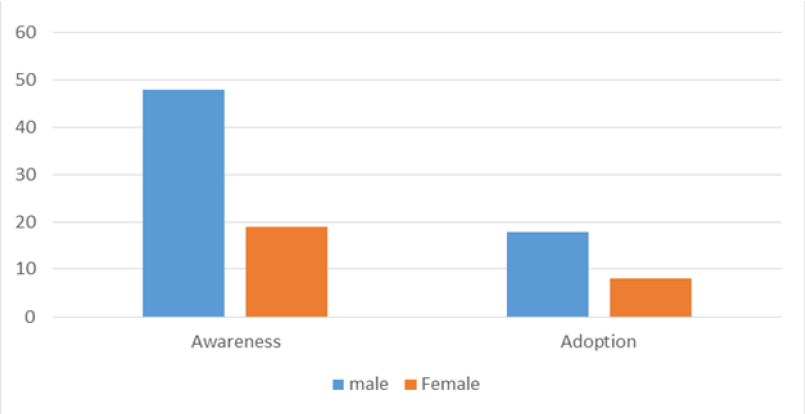


Figure 4.7: Respondenst level of awareness and adoption of assistive technology according to gender

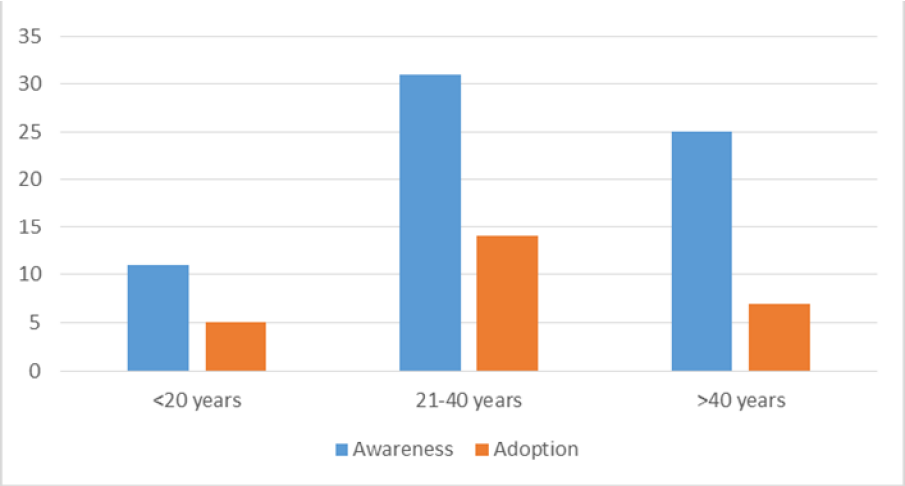


Figure 4.8: Respondenst level of awareness and adoption of assistive technology according to age group

4.3 Major Challenges Facing the Blind and Visually Impaired With Respect To Harnessing the ICT Support Services.

Analysis of the questionnaire responses show that the major cause of non-adoption of Assistive technology include could be summarized into three main category, which are: Ignorance, Poverty and Inaccessibility. Ignorance is reflected in the level of awareness and adoption of assistive technology as depicted in section 4.3 above. Ignorance accounts for about 59% of the causes of non-adoption or harnessing of ICT support services of assistive technology. Further analysis reveals that poverty and affordability accounts for yet another 27%, while inaccessibility and /or non-availability accounts for the remaining 14%. Table 4.5 and figure 4.9 below shows the main challenges facing the adoption of assistive technology by the respondents.

Table 4.5: major challenges facing adoption of assistive technology

Challenges to adopting AT	No of respondents	%
Ignorance	95	58.6
Poverty /affordability	36	22.2
unavailability / Accessibility	31	19.1

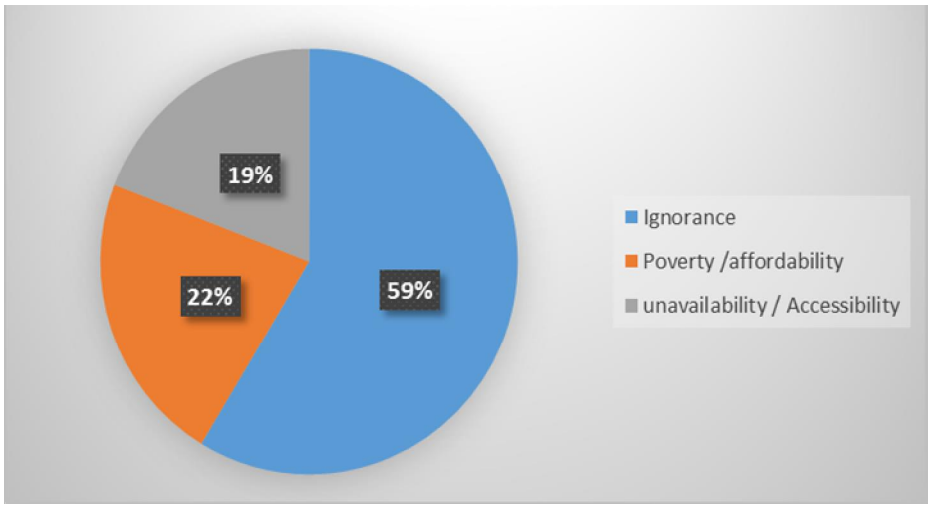


Figure 4.9: major challenges facing adoption of assistive technology

4.4 SYSTEM IMPLEMENTATION

4.4.1 Coding

This is the main program from the current or new system design; see Appendix for the source code.

4.4.2 Testing and Validation

The program was tested by allowing about 5 blind persons to use the program as a word processor, they supplied text such as ôI am typingö, ôThis is very funö, ôI can hear what I am typing as I typeö, ôNow I can type without feeling I might have typing errorsö, ôNever new this could workö, etc. The program was able to function as designed and the users where so excited to be able to create documents with ease. This text inputs resulted in a voice output through speakers attached to the computer system. The output were validated against the inputs and it was clear in pronunciation as written. When the text data is deleted backward, the program knowing the word is no longer complete, would spell out the letters instead of reading as a word.

4.4.3 Documentation

To install the SpeechApp Software, do the following:

1 Insert the CD containing the software and then.

2 Double click on the setup file to install software. After installation,

3 Go to start button below on the desktop,

4 Go to all programs and then click on SpeechApp,

5 On clicking this, the software will load.

The software is developed in such a way that anybody, weather with the knowledge of computer or not, can access it. The software SpeechApp is simple to use. Type your text files in the provided typing area, and as you type, the computer reads to you what you have typed, if you make a mistake in typing a letter you donôt intend, you are allowed to delete it and as you do, the computer reads along with you.

4.4.4 Training and Re-Training of User

Much training is not needed since the application is user-friendly.

4.4.5 Change-over Procedure

A direct change over technique would be use for changing from the old system to the new one and this instills that the old system is discontinued summarily while the new system is made operational immediately. The parallel change over technique is chosen, for this project, as a changeover technique can be easily assimilated.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

This research has made attempt to explore the available information communication technology (ICT) assistive technology specifically designed to engage and improve the computing experience of the blind (no vision) and visually impaired. A critical assessment of the assistive technology designed for the blind and visually impaired reveals that the seemingly digital divide caused by ICT can also to correct by innovations in ICT that makes special provision for both the blind and the visually impaired. Such assistive technologies include but not limited to specialized keyboards and voice enabled inputs/ outputs and other magnifying technologies. Even the limitations setup by touch screen technology have been bridged by special touch screen technology for the blind and visually impaired.

Analysis of the respondentôs awareness of assistive technology reveals an alarming 95 respondents out of the 162 representing 59% are not aware of any form of assistive technology. On Adoption of assistive technology, only 26 out of 162 respondents 16% have used one form of assistive technology or the other.

This study demonstrated that the higher the educational status of the respondent, the higher the level of awareness and adoption of assistive technology. Males have better awareness and adoption than females, while the mid age group of 21- 40 years are more likely to be aware and use assistive technology

Major challenges of adoption of assistive technology are Ignorance, poverty and accessibility with 59%, 22% and 19% respectively. Here, development of useful SpeechApp in the form of a simple application that converts inputted text into synthesized speech and reads out to the user which can then be saved. Voice application (SpeechApp) is a synthesizer software that converts text into spoken word, by analyzing and processing the text using Natural Language Processing (NLP) and then using Digital Signal Processing (DSP) technology to convert this processed text into synthesized speech representation of the text. The development of a voice synthesizer will be of great help to blind people and make making through large volume of text easier.

5.2 CONCLUSION

This study has shown the untapped possibilities to bridge the digital divide in Nigeria, visibly in non-adoption of assistive technology due to ignorance, poverty and possibly the inaccessibility of assistive technology. The statistics are not at par with international best practices observed in developed countries. There exist high potentials of bridging the digital divide by creating awareness, ensuring adoption and empowering the blind (no vision) and visually impaired to harness assistive technologies. SpeechApp has long been a vital assistive technology tool and its application in this area is significant and widespread. It will allow environmental barriers to be removed for people with a wide range of disabilities. For example, speech synthesis, combined with speech recognition, allows for interaction with mobile devices via natural language processing interfaces.

5.3 RECOMMENDATIONS

The following recommendations are made to improve the lot of the blind and visually impaired, using assistive technology:

1. Awareness creation and sensitization of assistive technology among the blind and visually impaired.
2. Proper legislation that considers the application of ICT assistive technology to help bridge the digital divide separating the blind and visually impaired from the general public.
3. Enforcement of compulsory provisions of assistive technology in all education institutions with the blind and visually students.
4. Provision of assistive technology alternatives in public places with ICT usage such as banks, business centers, cyber café, libraries etc.
5. All ICT hardware and software vendors should make available assistive technology for the blind and visually impaired.
6. Special education teachers should be trained in the use of assistive technology in order to impact the knowledge of their use to blind and visually impaired.

This Project is recommended for all visually impaired (blind) who is computer literate is advice to use this software, so that they can use their hand to correct their typing work without the help of any body. I therefore simply recommend the implementation of the project work for institution that are teaching blind people to make use of this Text ï to ï Speech application for the benefit for their students. Finally, I recommend this project to the government to create awareness among the blind on the existence of this application.

I also recommend further studies on this topic, irrespective of the fact that it has already added value to the body stock of knowledge. This is to unveil areas not properly dealt with at this time as a result of some circumstances beyond my control. Further studies should be carried out not letting this work cause any hindrance but matter, as a motivator for adequate knowledge.

REFERENCES

[1] Resnikoff S, Pascolini D, Etyaĉale D, et al. Global data on visual impairment in the year 2002. World Health Organization. Bull 2004; 82:844ï 851, 2002

[2][8] Sightsaver Nigeria , Important data about blindness in Nigeria, web based publication, last visited 12/06/2014 from http://www.sightsavers.org/our_work/around_the_world/west_africa/nigeria/default.html

[4] Gabriel E., (2012), Nigeria: Albinism is not a curse web article http://allafrica.com/stories/201204110272.html last accessed 21/5/2012.

[5] Pike, G. Disability access and the Internet. *Information Today, 20*(2), 19-20*,* 2003

[6] Raymond L & Lucy U. ñScoping Study: Disability Issues in Nigeria -Final Reportò DFID press, 2008.

[7][9] Kyari et al, Prevalence of Blindness and Visual Impairment in Nigeria: The National Blindness and Visual Impairment Survey IOVS, May 2009, Vol. 50, No. 5, 2009.

[10] Chaudhry and Shipp, Rethinking the Digital Divide in relation to Visual Disability in India and the United States: Towards a Paradigm of "Information Inequity" Society for Disability Studies Chicago, Disability Studies Quarterly Spring, Volume 25, No. 2, 2005

[11] UNESCO ñTogether for accessibility: ICT for the blind and visually impairedò a web based publication, 2010 last visited 09/05/2012 from http://portal.unesco.org/ci/admin/ev.php?URL_ID=23783&URL_DO=DO_TOPIC&URL_SECTION=201&reload=1337451300&PHPSESSID=876cff8568bd96b61a378528c2aaf926

[12] British Broadcasting Corporation News Online, 2012. Last accessed on 09/04/2014 from http://www.bbc.com/news/technology-17105225#main-content

[14] Disaboom ñAssistive Technology: Top 8 Free Browsers for Visual Impairment and Moreò web based publication, 2012 last accessed on 12/04/2014 from http://www.disaboom.com/vision-and-hearing-technology

[15] Putnam, R. *Making democracy work: Civic traditions in modern Italy*. Princeton, NJ: Princeton University Press, 1993.

[16] Braille. Encyclopædia Britannica Online, 2016. Retrieved 12 December, 2014, from http://www.britannica.com/topic/Braille-writing-system

[17] http://www.afb.org/info/living-with-vision-loss/using-technology/assistive-technology/123

[18] http://www.who.int/mediacentre/factsheets/fs282/en/

[19]http://pbunion.org/Countriessurveyresults/Nigeria/Nigeria_survey_Summary_report.pdf

[20] Agbaje, S. A. (2000). Library services to the visually impaired: Nigeria strides into the 21st century. Journal of the Association of Libraries for the Visually Handicapped, 1(1), 38ï 46.

[21] http://research.spa.aalto.fi/publications/theses/lemmetty_mst/chap2.html

[22] http://shodhganga.inflibnet.ac.in/bitstream/10603/50844/8/08_chapter%201.pdf

[23] http://www.cs.indiana.edu/rhythmsp/ASA/Contents.html

[24] http://www.informationweek.com/government/mobile-and-wireless/text-to-speech-apps-aid-students-with-dyslexia/a/d-id/1315720

[25] http://leadership.ng/features/370232/revisiting-challenges-facing-people-disabilities

[26] Clear, M. (2000). Promises, Promises : Disability and Terms of Inclusion. Leichhardt: Federation Press.

[27] Sainsbury, S. (1973). Measuring Disability. Birkenhead: Social Administration Research Trust.

[28] Drake, R. (1999). Understanding Disability Policies. London: MacMillian. European Agency for Safety and Health at Work. (2002). People with Disabilities. Retrieved 20 September, 2004, from http://europe.osha.eu.int/good_practice/person/disability/indexbytopic11.php ?id=471\

[29] Lane, T. (2000). ALP National Conference - Australia and the Region. Retrieved 2 January, 2006, from http://www.abc.net.au/rn/talks/natint/stories/s156944.htm

[30] Bourk, M. (2000). Telecommunications Policy in Australia and People with Disabilities. Canberra: TOMW Communications.

[31] United Nations Statistics Division. (2004). Human Functioning and Disability. Retrieved 20 September, 2004, from http://unstats.un.org/unsd/demographic/sconcerns/disability/

[32] Goggin, G., & Mewell, C. (2003). Digital Disability - The Social Construction of Disability In New Media. New York: Rowman and Littlefield.

APPENDIX I
QUESTIONNAIRE

ICT ASSISTIVE TECHNOLOGY FOR THE BLIND AND VISUALLY IMPAIRED PERSONS

Introduction:

This questionnaire is strictly for an academic exercise and would therefore hold in utmost confidence the responses of respondents. Kindly provide the correct responses by ticking the appropriate box

1. Gender

    [ ] Male

    [ ] Female

2. Age

    [ ] less than 20 years

    [ ] 21 to 40 years

    [ ] above 40 years

3. Educational Status

    [ ] None

    [ ] Primary Education

    [ ] Secondary Education

    [ ] Tertiary Education

4. Nature of visual impairment

    [ ] Blind (No Vision)

[ ] Visual Impairment

5. Are you aware of Assistive technology for the blind and visually impaired?

   [ ] No

   [ ] Yes

6. If answer to question 5 above is Yes, then please list the Assistive technologies you are aware of

   (i) _____

   (ii) _____

   (iii) _____

7. Have you used any Assistive Technology to improve your vision?

   [ ] No

   [ ] Yes

8. What are the challenges militating against the blind and visually impaired from using ICT Assistive Technology?

   (i) _____

   (ii) _____

   (iii) _____

APPENDIX II

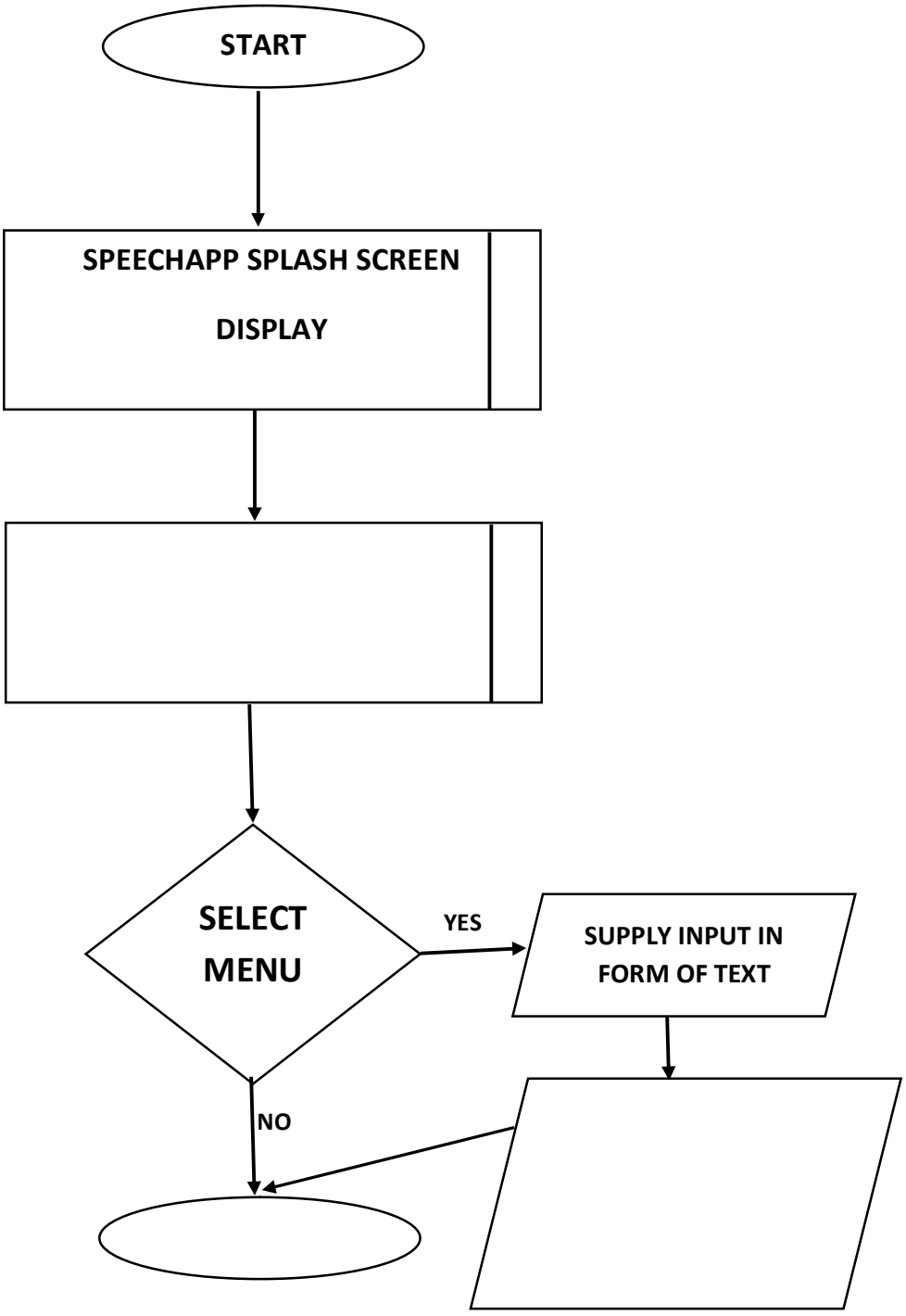
LIST OF SCHOOLS FOR THE BLIND IN NIGERIA

S/N	NAME	LOCATION
1.	Special Education Centre	Oji River, Enugu, Anambra State,
2.	Open Education Scheme	Benin, Edo State,
3.	Oturkpo Blind Men's Workshop	Oturkpo L. G. E. A., Oturkpo, Benue State,
4.	St. Francis' School For The Deaf And Blind	P. O. Box 43 Vandeikya, Benue State,
5.	Open Education Centre Scheme	Maiduguri, Borno State
6.	Open Education Scheme	Calabar, Cross River State
7.	St. Joseph's Blind Centre	Obudu, Cross River State
8.	Special Education Unit	c/o H. E. A. School, Agodi Ibadan,
9.	Open Education	Domestic Centre Building, Ibadan
10.	Special Education Centre Orlu	Orlu, Imo State
11.	Basawa Teachers' College	Kaduna State
12.	Government Secondary School Fadankaje	c/o Ministry of Education, Kaduna
13.	Open Education Scheme For The Blind	Kaduna
14.	School For The Blind	Sudan Interior Mission, Kano
15.	Kano School For The Blind	Kano
16.	Katsina School For The Blind	Katsina
17.	Kwara State School For The Blind	Ilorin
18.	Nigeria Farmcraft Centre For The blind	Ikeja, Lagos
19.	Pacelli School For Blind Children	Surulere, Lagos
20.	St Joseph's Day Care - School For The blind	Obudu, Cross River State
21.	School For Handicapped Children	Shagamu-Remo, Ogun State
22.	School For Handicapped Children	Ijebu-Ode, Ogun State.
23.	Ondo State School For The Blind	Ondo
24.	Marcus Garvey Uhuru Library	Ila-Orangun, Oyo State
25.	Oyo State Blind Centre	Ogbomosho, Oyo State
26.	Iwo Baptist College, Special Unit	Oke-Ode, Iwo Oyo State
27.	School For The Handicapped	Ikirun, Oyo State
28.	Gindiri School For Blind Children	Church of Christ in Nigeria Gindirin, Near Jos, plateau State
29*	The Albino Foundation	National Office (Abuja) and State Chapters

* The entire Albino Foundation is seen as an institute of its own.

APPENDIX III

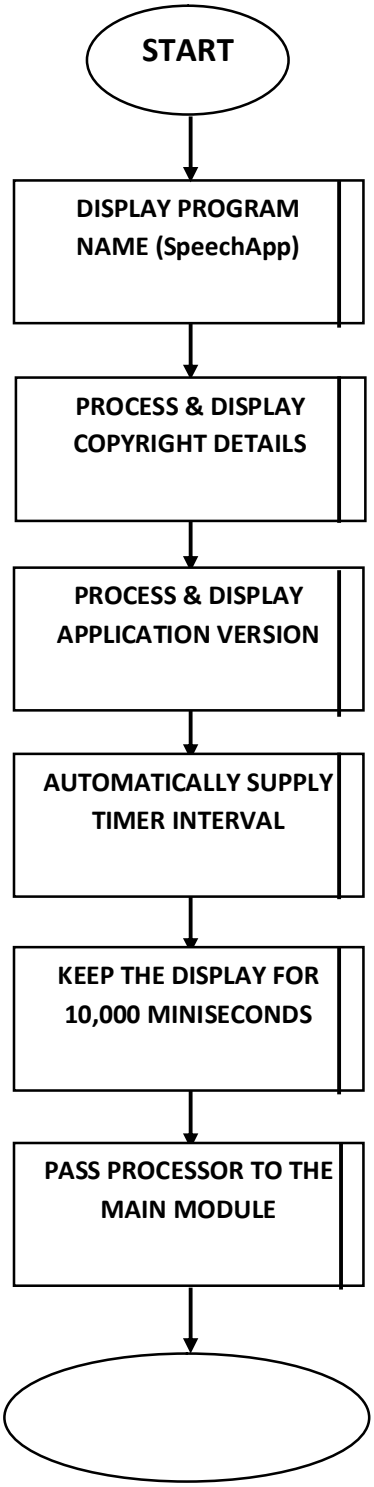
SYSTEM FLOWCHART



APPENDIX IV

PROGRAM FLOWCHART 1

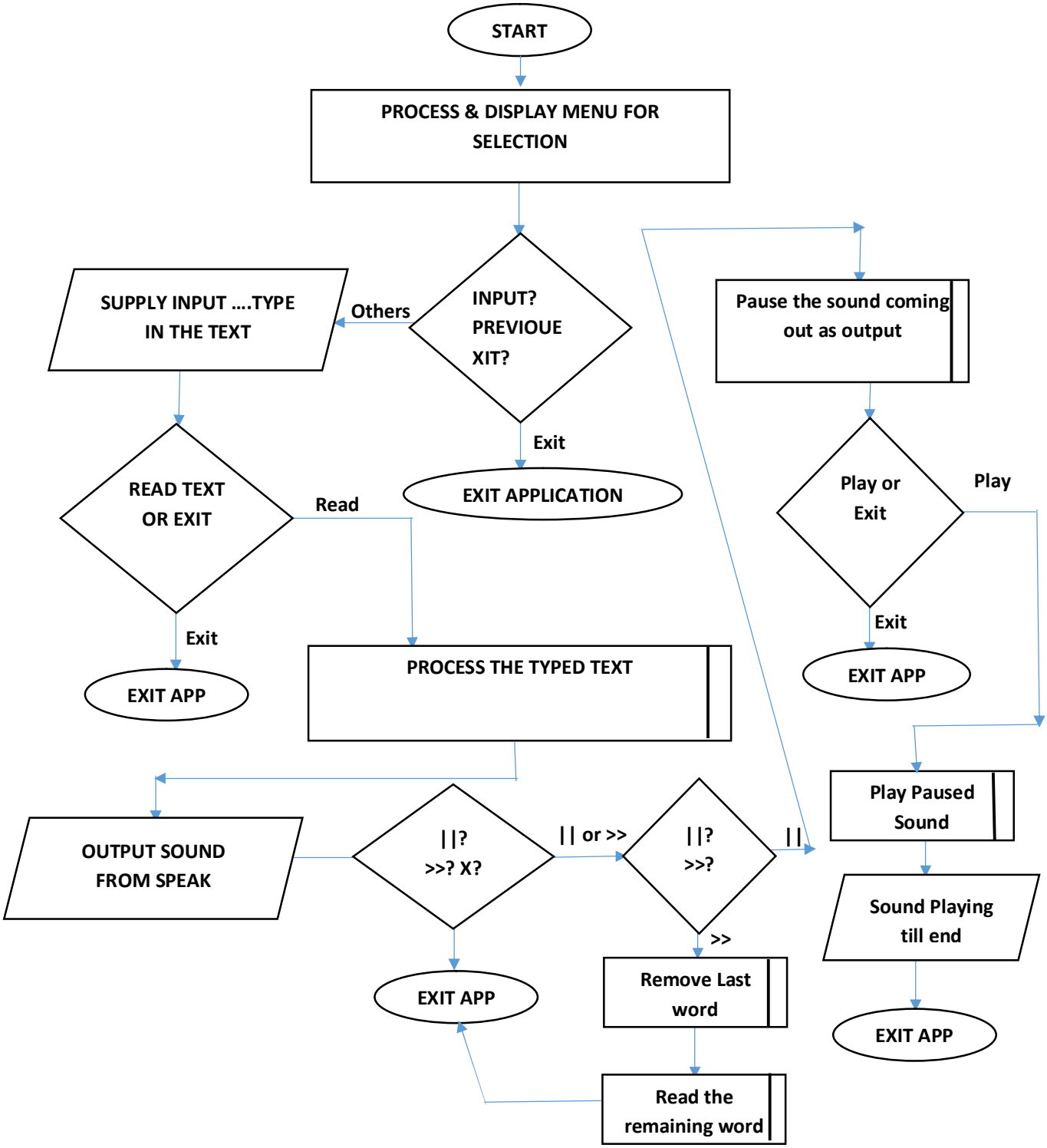
Splash Screen Module



APPENDIX V

PROGRAM FLOWCHART 2

Main Menu Module

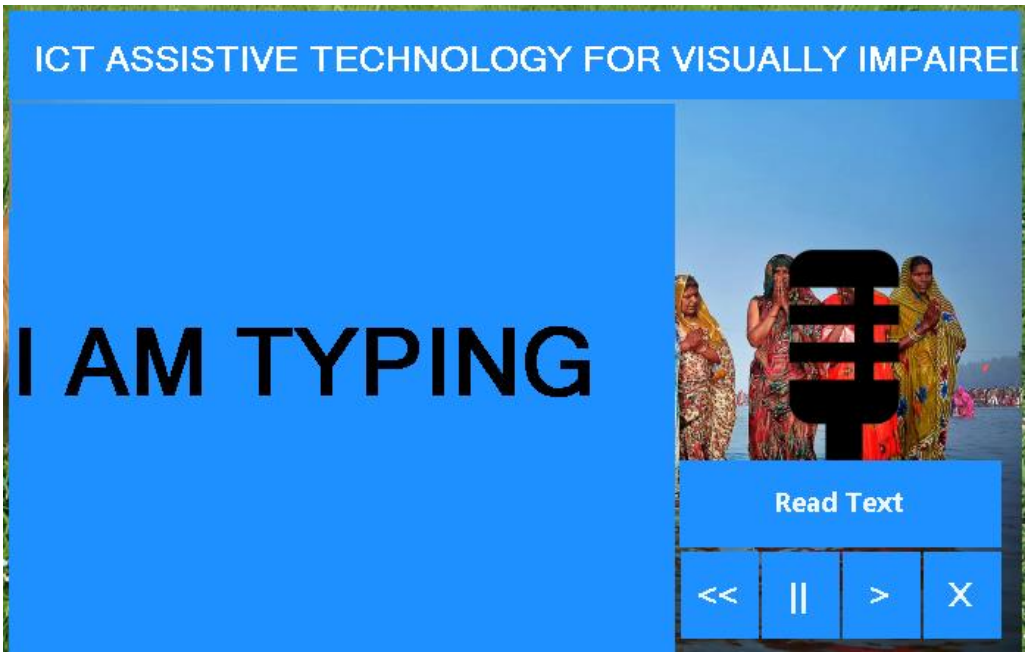


APPENDIX VI

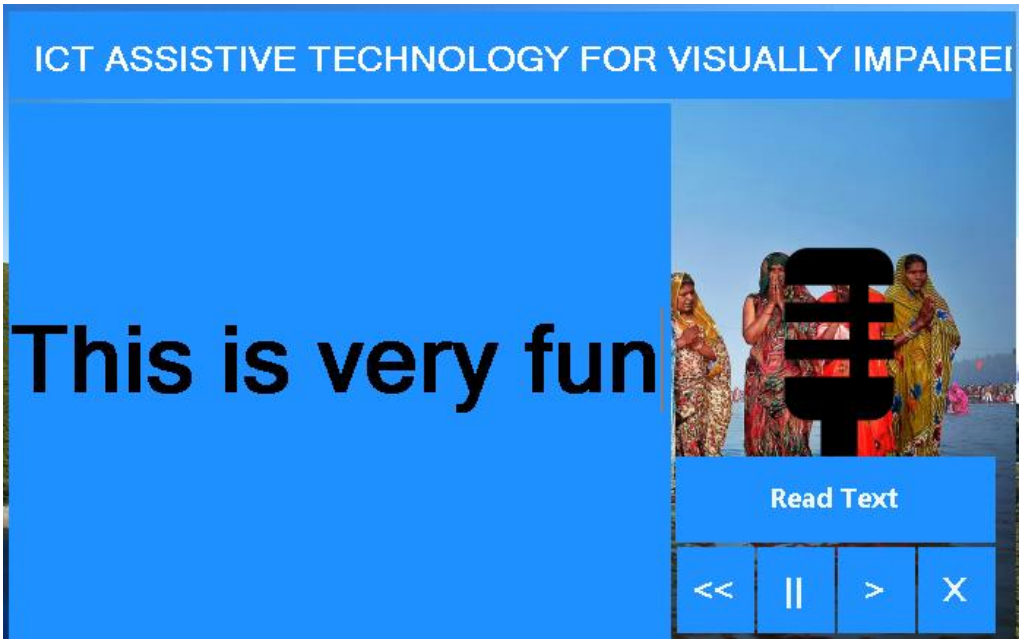
PROGRAM INTERFACES

Splash Screen Design

Main Program Interface



Typing in progress (Testing)



More Typing (Testing & Validation)

APPENDIX VII
PROGRAM SOURCE CODE

```
Imports System

Imports System.Collections.Generic

Imports System.ComponentModel

Imports System.Data

Imports System.Drawing

Imports System.Linq

Imports System.Text

Imports System.Threading.Tasks

Imports System.Windows.Forms

Imports System.Speech

Imports System.Speech.Recognition

Imports System.Speech.Synthesis

Public Class main

    Dim Rom As Random = New Random()

    ' set up the Speech Recogintion


    Dim MyEngine As SpeechRecognitionEngine = New SpeechRecognitionEngine()




    Dim MySyn As SpeechSynthesizer = New SpeechSynthesizer()
```

```
    '------------------------------------------------------------
    ' Converted from C# to VB .NET using CSharpToVBConverter(1.2).
    ' Developed by: Sunday Prince
    '------------------------------------------------------------

    Private Sub ReadTextButton_Click(sender As Object, e As EventArgs) Handles
ReadTextButton.Click

        If String.IsNullOrEmpty(richTextBox2.Text) Then
            MySyn.SpeakAsync("Sorry i can't read  , Enter a text first ")
        Else

            MySyn.SpeakAsync(richTextBox2.Text)

        End If
    End Sub

    Private Sub RichTextBox1_TextChanged(sender As Object, e As EventArgs)
Handles RichTextBox1.TextChanged
        richTextBox2.Text = richTextBox2.Text + RichTextBox1.Text
```

```
        If String.IsNullOrEmpty(richTextBox2.Text) Then
            MySyn.SpeakAsync("Sorry i can't read  , Enter a text first ")
        Else

            MySyn.SpeakAsync(RichTextBox1.Text)

        End If
        RichTextBox1.Clear()

    End Sub

    Private Sub btnback_Click(sender As Object, e As EventArgs) Handles
btnback.Click
        If richTextBox2.Text <> "" Then
            Dim totalText As Integer = richTextBox2.Text.Length
            Dim k As Integer = totalText - 1
            richTextBox2.Text = richTextBox2.Text.Substring(0, k)
        End If
    End Sub

    Private Sub ReadTextButton_MouseHover(sender As Object, e As EventArgs)
Handles ReadTextButton.MouseHover
        MySyn.SpeakAsync("Read Text")
```

```
    End Sub

    Private Sub ExitButton_Click(sender As Object, e As EventArgs) Handles
ExitButton.Click

        Application.Exit()

    End Sub

    Private Sub Form1_Load(sender As Object, e As EventArgs) Handles
MyBase.Load

    End Sub

    Private Sub PauseButton_Click(sender As Object, e As EventArgs) Handles
PauseButton.Click

        If Not MySyn Is Nothing Then
            If MySyn.State = SynthesizerState.Speaking Then
                MySyn.Pause() ' make the program Pause the Reading

            End If

        End If
```

```
        '------------------------------------------------------------
        ' Converted from C# to VB .NET using CSharpToVBConverter(1.2).
        ' Developed by:Sunday Prince
        '------------------------------------------------------------

    End Sub

    Private Sub ContinueButton_Click(sender As Object, e As EventArgs) Handles
ContinueButton.Click

        If Not MySyn Is Nothing Then
            If MySyn.State = SynthesizerState.Paused Then


            End If

        End If

        '------------------------------------------------------------
        ' Converted from C# to VB .NET using CSharpToVBConverter(1.2).
        ' Developed by: Sunbday Prince
        '------------------------------------------------------------
```

```
    End Sub

    Private Sub PauseButton_MouseHover(sender As Object, e As EventArgs) Handles
PauseButton.MouseHover
        MySyn.SpeakAsync("Pause")
    End Sub

    Private Sub ContinueButton_MouseHover(sender As Object, e As EventArgs)
Handles ContinueButton.MouseHover
        If String.IsNullOrEmpty(richTextBox2.Text) Then
            MySyn.SpeakAsync("Continue")

        End If
    End Sub

    Private Sub btnback_MouseHover(sender As Object, e As EventArgs) Handles
btnback.MouseHover
        MySyn.SpeakAsync("Back Space")
    End Sub

    Private Sub ExitButton_MouseHover(sender As Object, e As EventArgs) Handles
ExitButton.MouseHover
        MySyn.SpeakAsync("Exit")
```

```
    End Sub

End Class

Public NotInheritable Class SplashScreen


    'TODO: This form can easily be set as the splash screen for the application by going to the "Application" tab

    '  of the Project Designer ("Properties" under the "Project" menu).



    Private Sub SplashScreen_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles Me.Load

        'Set up the dialog text at runtime according to the application's assembly information.


        'TODO: Customize the application's assembly information in the "Application" pane of the project

        '  properties dialog (under the "Project" menu).


        'Application title

        If My.Application.Info.Title <> "" Then

            ApplicationTitle.Text = My.Application.Info.Title

        Else

            'If the application title is missing, use the application name, without the extension
```

```
            ApplicationTitle.Text =
System.IO.Path.GetFileNameWithoutExtension(My.Application.Info.AssemblyName
)
        End If

        'Format the version information using the text set into the Version control at
design time as the
        '  formatting string.  This allows for effective localization if desired.
        '  Build and revision information could be included by using the following code
and changing the
        '  Version control's designtime text to "Version {0}.{1:00}.{2}.{3}" or
something similar.  See
        '  String.Format() in Help for more information.
        '
        '    Version.Text = System.String.Format(Version.Text,
My.Application.Info.Version.Major, My.Application.Info.Version.Minor,
My.Application.Info.Version.Build, My.Application.Info.Version.Revision)

        Version.Text = System.String.Format(Version.Text,
My.Application.Info.Version.Major, My.Application.Info.Version.Minor)

        'Copyright info
        Copyright.Text = My.Application.Info.Copyright + " All Rights Reserved."
    End Sub
```

```
    Private Sub Timer1_Tick(sender As Object, e As EventArgs) Handles Timer1.Tick

        main.Show()

        Me.Hide()

    End Sub

End Class
```