



DEVELOPING ICT BASE VIRTUAL ASSISTIVE SYSTEM IN SUB-SAHARA AFRICAN INDIGENOUS LANGUAGE YORUBA LANGUAGE OPTION TO PROMOTE VIRTUAL COLLABORATION ABILITY OF INTELLECTUALLY CHALLENGED YORUBA ETHNICS LIVING IN RURAL COMMUNITIES FOR SUSTAINABLE DEVELOPMENT DURING THE COVID 19 LOCK DOWN.

I.K. OJUOPE¹; A.O. ADETUNMBI²; & O.E. OYINLOYE³

¹Department of Computer Science, Aminu Saleh College of Education, Azare, Bauchi State, Nigeria. ²Department of Computer Sci., Federal Uni. of Tech., Akure, P.M.B. 704, Akure, Ondo State. ³Department of Comp. Sci., Ekiti State University, Ado Ekiti, Nigeria.

ABSTRACT

The inception of COVID 19 Corona virus pandemic disease has brought about the challenge of using Information and Communication Technology (ICT) in teaching and learning systems. The use of ICT in education is no longer a new idea, but the question is where the limit is when the use of ICT does not have the desired effect, most especially on the Intellectually Challenged individuals that cannot read and write in English Language. Most systems were developed without considering the fact that, there are different categories of users including people living with disabilities. From the report of World Health Organization (WHO) and World Bank (2011), physically challenged persons consist a significant proportion of the world's population, about 15%, due to the differences in their educational level to the normal individuals, they are not always see as contributor to productive human capital development of the Society. Most of the Intellectual Challenged students have little access to education; this is as a result of difficulties they face in learning and comprehension. This paper focuses on the Developing ICT Base Virtual Assistive System in Sub-Sahara African indigenous Language Yoruba

Language option to promote Virtual Collaboration Ability of Intellectually Challenged Yoruba Ethnics Living in Rural Communities for Sustainable Development during the COVID 19 Lock Down. It also compares the degree of efficiency of assistive System in Yoruba Language with the existing Applications in English Language. The design and methodology was based on the research work we carried out in one of the government school for handicap children in Nigeria. From the cognitive ability testing of the research, we found out that the students learn faster and easier with the use of Yoruba developed applications than English Language developed applications. Base on this, developing ICT base virtual applications in Yoruba Language option that will encourage the virtual learning ability of these individuals during the COVID 19 pandemic outbreak is highly imperative.

Key words: *Sub-Sahara African, Indigenous Language, Virtual Assistive System, Information Technology, Intellectual Challenge, Yoruba Language, Yoruba Rural Ethnics, Sustainable Development, COVID 19 Pandemic lock down.*

INTRODUCTION

From the report of the research conducted by the World Health Organization (WHO) and World Bank (2011), physically challenged individuals carry a significant proportion of the world's population, about 15%; as a result of differences in educational standard to the normal individuals, they are rarely seen as contributor to productive human capital development of the Society. Most of the Intellectually Challenged students have little access to education, this is as a result of several challenges they face in learning and understanding. They find it difficult to learn and comprehend fast (Radka and Petr, 2016); as a result of this challenges, the need for assistive technology to enhance their learning ability is imperative. From the research we conducted in one of the government schools for handicap children, we discovered that these category of students find it difficult to learn and comprehend using English Language. As a result of this, these individuals were cut off during this COVID 19 pandemic disease when teaching and learning is becoming ICT based virtual reality and most of the system applications were developed in English Language. Developing Assistive System in Yoruba language would be a greater advantage

to these students, it would make ICT based Virtual classes easier, efficient and convenient for them. It will also make Digital Inclusive a reality unto these physically challenged users in this COVID 19 pandemic global challenges. Human-computer interaction (HCI) is concerned with the design, evaluation and implementation of interactive products for easy, efficiency, reliable, enjoyable, effortless, and effective to all categories of users (Zhong et al. 2019) and (Shneiderman, and Plaisant, 2010). The aim of this research work is to develop and integrate a robust assistive, accessibility and usability system in Yoruba Language for the intellectually challenged individuals during the COVID 19 pandemic challenge, with a combine concept of Text / Image enlargement technology and Text to speech architecture (Joyce et al 2007). According to the tenth revision of WHO: Intellectual disability is a disorder defined by the presence of incomplete or arrested mental development, principally characterized by the deterioration of concrete functions at each stage of development and that contribute to the overall level of intelligence, such as cognitive, language, motor and socialization functions; in this anomaly, adaptation to the environment is always affected (Katz and Lazcano, 2008). From the report of Intellectual Disability Rights Service Inc. (2009), Intellectual disability is a disability which occurs in the developmental period of life (i.e. before the age of 18) and is characterised by below average intellectual functioning.

Clinical description of Cognitive Affected Persons

From the report of Cognitive Impairment Rights Service Inc. (2009), Intellectual challenge is a disability which manifest during the developmental period of life that is before the age of 18, and is characterised by below average intellectual functioning. Several people with Cognitive Impairment are born with the disability. Significantly sub-average collective intellectual functioning is defined as approximately 70 IQ or below as measured by a qualified psychological examiner on Intellectual disability, nationally formed standardized measures of intelligence.

Clinically, and for the purposes of proving that a person has Intellectual disability, Intellectual disability is best assessed by a psychologist as:

- I. an IQ of 70 or under.
- II. deficits in at least 2 areas of adaptive behaviour, that is:

- a. Communication
- b. Self-care
- c. Home living
- d. Social skills
- e. Self direction
- f. Leisure and work
- g. Learning.

In clinical terms, Intellectual disability is often defined in terms of the severity of the disability.

Table 1 Clinical description of Intellectual disability

Level of disability	% of people with Intellectual disability	IQ
BORDERLINE		70-75
MILD (Educable)	75%	55-70
MODERATE (Trainable)	20%	30-55
SEVERE (Totally dependent)	5%	under 30

Source: (IDRS Inc. 2009)

People with Intellectually Challenged Person have little or no access to education due to reasons as:

- a. poor societal perception of persons living with disability
- b. poor funding
- c. policy instability
- d. lack of commitment
- e. curriculum development and

Expression of Yoruba Standard Word

Yorubá is one of the three major languages spoken in Nigeria. Yoruba language is spoken by the South western part of Nigeria and other countries like Republic of Benin, Togo and part of Ghana. It is widely spoken

language because of its prevalence both in Nigeria and outside Nigeria (Odetunji, 2008).

The Yoruba Alphabet

Yoruba alphabet has 25 letters which is made up of Eighteen (18) consonants (represented by the graphemes: (*b, d, f, g, gb, h, j, k, l, m, n, p, r, s, s., t, w, y*) and seven (7) vowels (*a, e, e., i, o, o, u*) while the Latin Letters <c> , <q> , <v> , <x> , <z> are not used. There is also addition of a diagraph <gb> which combines two consonants together that form a unit (Adeyemo and Idowu, 2015).

Yoruba Vowel

Phoneme Orthography Examples English

/a/ a ajá 'dog'

àbá 'motion'

/e/ e ewé 'leaf'

Ètè 'lips'

as in English bait

/ẹ/ ẹ è j è blood

ẹ f è jest

as in English 'bet'

/i/ I ìrì 'dew'

Ìdí 'buttocks'

as in English 'beat'

/o/ o owó 'money'

òdo 'zero'

as in English 'boat'

/o/ or /□/ c ọfọ

incantation

ọjó ,day

as in English ‘bought’
/u/ u ojú ‘eye/face’
òwú ‘thread’
as in English ‘boot’

Adapted from:

African Studies Institute manual, University of Georgia, USA

RELATED WORKS

Zaagsma et al (2020) worked on the use of online support by people with intellectual disabilities living independently during COVID-19. The global outbreak of the COVID-19 virus and the control measures imposed by governments focused on containing its spread have a dynamic impact on the provision of social care and support services made available for people with disabilities around the world (Armitage and Nellums 2020). It seems likely that also people living with intellectual challenges are at risk of experiencing a discontinuation of support to some extent. For example, in the Netherlands, while residential care services for people with Intellectual Disabilities (IDs) continued, visits from friends, family and relations were mostly prohibited. Services such as day activity centres and meeting centres, as well as other gatherings, were put on hold for several months (Woittiez et al. 2020). In the period of COVID-19 pandemic outbreak, service providers in the Netherlands had to move towards providing local support for people with intellectual challenges living independently.

Neece et al. (2020) worked on the COVID-19 pandemic introduced challenges to families with young children with developmental delays. Above the sphere of the widespread concerns surrounding physical challenges, sickness or loss of employment and social isolation, caregivers are responsible for looking after their children’s educational and therapeutic programmes at home at times without the much needed support of professionals. The study sought to examine the impact of COVID-19 in 77 socioeconomically, linguistically and ethnically. The response of parents were taken on five interview questions on the impact of the COVID 19 pandemic, services delivered for their child, positive aspects, coping with the situation and their concerns about the long-term impact of the pandemic. From the study, it was discovered that Parents reported that their

biggest challenge was staying home caring for their children without the presence of many essential services. Parents also reported the positive aspects of the pandemic, most especially being together as a family.

Ojuope, Adetunmbi and Oyinloye (2019) conducted a study on the use of assistive system for empowering persons with Intellectual Challenges for meaningful lives in the Digital Economy. The study described Digital inclusion as the concept where Information and communication technology (ICT) provide easy, reliable, and effective accessibility to all categories of users. It was observed that most interfaces were developed without considering the fact that, there are different categories of users including people living with disabilities. The paper focused on the developing service-security based usability interface that will empower and provide security for this category of users and also promote their user experience; and as well compare the degree of efficiency of a secured assistive Interface with the existing interfaces. Theoretical framework on Human computer interaction (HCI) and the new Security Human Computer Interaction (HCI-S), were also carried out and several related articles were reviewed. The user model was tested based on the concept of User Satisfaction Performance/Essential Usability Metrics. Effectiveness/Efficiency/Analysis of reading Errors, The Mean Percentage, and Task Completion (in seconds) were used as the performance measure technique for evaluation. The result showed that the model developed had a mean percentage performance of 98% and the mean time taken to perform a task in 32secs. The model was successful for people with intellectual disability.

Ojuope and Adetunmbi (2018) worked on Empowerment of Persons with Intellectual Challenges for sustainable Development. The aim of the paper is empowering individuals living with Intellectual disability and builds the skills necessary to ensure that human empowerment is an advantage to achieve sustainable development goals in Nigeria. Nigeria in recent time have been threatened with alarming scenario as a result of unemployment which resultant effects ranges from extreme poverty, hunger to insecurity. Consequently, the application of Information and Communication Technology have not be vigorously harnessed to its fullest despite its perceived vocational and wealth creation opportunities. Nigeria is the most populous state in Africa, The increase in population without availability of resources to manage this growth has become a worry to Nigerian citizens. Hundreds of Thousands of people living

with disability are without any hope for the future. The advent of Information Technology has brought about various opportunities including job creation, business strategy and planning etc. Information Technology is the bedrock for economic survival and development in a rapidly changing global economy. The availability and the use of information technology are prerequisite for economic and social development in our world.

Belkacem and Pigot (2008) worked on the evaluation of a contextual Assistant interface using cognitive models (GOMS). Analytical evaluation techniques allowed us to predict, among other users, user performance, time execution of tasks, how a design will perform and to explain the performance of an existing interface. The PDA (personal digital assistant) is deposited at a distance of 15 cm from the touchscreen; participants remain standing at a distance of approximately 30cm from the touchscreen during the entire test.

METHODOLOGY

This section analysed the difficulties faced by the intellectually challenged persons in accessing job and Information Technology device. From the research carried out by the author of this paper in Home School for Handicapped Children, Ibadan, Oyo State 2028, It was discovered that, these people have little or no access to computer and IT facilities due to the clustering of the Application tools. So they find it difficult to learn and comprehend. Users with intellectual disability have problem with navigating around applications, either due to the fact that:

- a. the tools are cluster and difficult to access
- b. the images / pictures of the tools are too small to understand
- c. the Text are not easy to memorise; and
- d. the Text are too small to learn and comprehend.

Developing assistive systems for these people becomes imperative; this will enhance digital inclusion of these people and further promote job creation.

Intellectual disabilities is significantly sub-average general intellectual functioning which exists concurrently with deficits in adaptive behaviour that adversely affects educational performance and originates before age 18. Intellectual disability does not include conditions primarily due to a sensory or physical impairment, Amyotrophic lateral Sclerosis (ALS), traumatic brain

injury, autism spectrum disorders, severe multiple impairments, cultural influences or a history of inconsistent and/or inadequate educational programming (WHO and World Bank, 2011).

From the report of Intellectual Disability Rights Service (IDRS) Inc. (IDRS, 2009)], Intellectual disability is a disability which occurs in the developmental period of life (i.e. before the age of 18) and is characterised by below average intellectual functioning. Most people with intellectual disability are born with the disability.

People living with intellectual disability have difficulties in access application interfaces, this problem involve, time spent to complete a particular task. From the study we carried out, we discovered that the target users never had access to computer / Internet facilities. This is because most of the application tools were developed in English Language which makes it difficult for users that cannot read and write in English Language to access. Also the tools of the applications being widely used are too complex for them to learn and comprehend. As a result of this, it will be more efficient for them to use simple and accessible applications. They need to use word processing (a simple word pad) with a few tools developed in Yoruba Language that will be easy and efficient for them to learn and use. The tools include: create new document (ise titun), save document (Fi pamo), open document (Si sita), print document (Tee sita), and open web browser (Si Ayelujara). Once they opened web browser, from there they can have access to other internet facilities such as, e-mail and face book (social network). The system can be used at a start with the Educable category of the intellectual disability due to their ability to learn and comprehend faster than the other categories.

Economic and social impact of Digital Inclusion of persons with intellectual disability.

Individuals living with intellectual disabilities have little or no access to the resources that drives economy base on:

- f. poor societal perception of persons living with disability
- g. poor funding
- h. policy instability
- i. lack of commitment
- j. curriculum development and

- k. focusing on resources base economy rather than knowledge base economy.

National Council on Disability (NCD) (2011) submitted that the power of Digital inclusion pave way for high job opportunities in the society and digital barrier has brought about low employment among people with disabilities. Manipulation of information has pave way for job creation for people with disability, it gives opportunity for these category of users to work alongside non-disabled people. Consequently, the job opportunity rate of persons with disability still remains extremely low (fig.1). Development and improvements in assistive technology can go a long way to bridge this gap. Information society is being built on technology, knowledge and intelligence; appropriate use of the knowledge by people with intellectual disability contributes to economic and social development. Information technology facilitates fast, cheap, equitable, and resource efficient; access to information, adequate research for learning opportunities become a support tools for job creation and sustainable development.

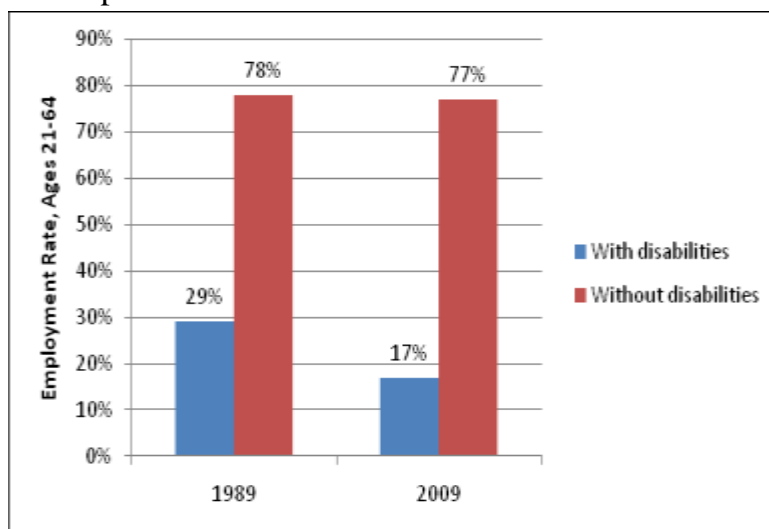


Figure 1: Comparing Employment Rates, 1989 and 2009. Source NCD 2011

Intellectual Challenges and the value of Sustainable development

The term “sustainable development” has been popularized by the world Commission Environment and Development (WCED), in its 1987 report titled “our common future”. The commission defined sustainable development as “the

development that meets the need of the present without compromising the availability of future generation to meet their own needs” (Nasrda, 2002). The development of novel and affordable information and communications technologies, and the emergency of information society with new economic models, has the potential for making major contributions toward sustainability of the earth’s ecosystems. Innovative use of information technology offer substitutes for travel and for the transportation of goods, and a major shift towards less resource intensive production, consumption, trade, and services. Such changes can significantly reduce the environmental impact, of industrial and commercial activities and thus contribute to sustainable development through productivity and development (Amazon, 1999).

Sustainable development stands on three pillars in terms of its definitions for the 2002 world summit on sustainable development (WSSD): and cited by National Space Research and Development Agency (NASRDA), social development, economic development and environmental protection (Nasrda, 2002). According to Nigeria National Information Technology policy 2001, its mission statement spelled out that the Information Technology should be used for: Education, Creation of wealth, Poverty eradication, Job creation and Global competitiveness. All these are ingredients of societal sustainable development. If People living with intellectual disabilities can be exposed to the power and possibilities of Information Technology, achieving the goals of sustainable development will be enhanced.

The Challenge of Intellectually Challenged during the COVID 19 Pandemic

This study aims to contribute to the knowledge on the usefulness of offering remote, online support to independently living people with ID during a time of crisis, when regular onsite services are not or less available. With this aim, we explored the use of DigiContact support during the first weeks of the COVID-19 pandemic. In this paper, we focus on the following question: how does the (planned and unplanned) use of online support by people with ID living independently evolve during the first weeks of the COVID-19 pandemic in the Netherlands?

Before the COVID-19 outbreak, the number of independently living persons with ID connected to DigiContact fluctuated around 700. During the pandemic,

282 additional persons were connected at the initiative of the service provider, to create a safety net for them in the event that many onsite support workers would fall ill and/or regular support (from a distance) could not be continued. Being connected to DigiContact means that several technical and administrative actions have been completed that enable a person to contact the service. A total of 648 service users had at least one contact during the first 20 weeks of 2019 and/or the first 20 weeks of 2020. Of these service users, 32 had been newly connected to DigiContact during (and due to) COVID-19 and therefore only had contacts during the pandemic. Table 1 presents the median scores and interquartile range of the number of contacts per day between DigiContact and its users: it indicates that the service dealt with a higher number of contacts per day during COVID-19 than during the two reference periods. Figure 2 presents the patterns in the number of contacts per day during the first 20 weeks of 2020 and 2019 and therefore gives a detailed view on how the amount of contacts evolved over the weeks. The 2020 patterns were more or less comparable with those of 2019 up to week 10/11. In weeks 11/12 (2020), the number of unplanned contacts per day considerably increased.

Table 1 Median scores and interquartile ranges of the amount of support contacts per day, during COVID-19 and two reference periods

Period	Service users contacts/day n	Unplanned contacts/day Mdn (IQR)	Planned contacts/day Mdn (IQR)	All Mdn (IQR)
Old service users	616			
COVID-19*	466	32.00 (24.00–40.00)	74.00 (70.00–79.00)	106.00 (96.00–116.00)
†	445	23.00 (19.00–28.00)	63.00 (57.00–70.00)	88.00 (78.00–97.00)
Ref. 2020				
‡	435	22.00 (18.00–26.00)	64.00 (57.00–72.00)	86.00 (77.00–97.00)
Ref. 2019				
New service users				
COVID-19*	32	0.00 (0.00–1.00)	1.00 (0.00–2.00)	2.00 (1.00–3.00)

Source: Zaagsma et al (2020).

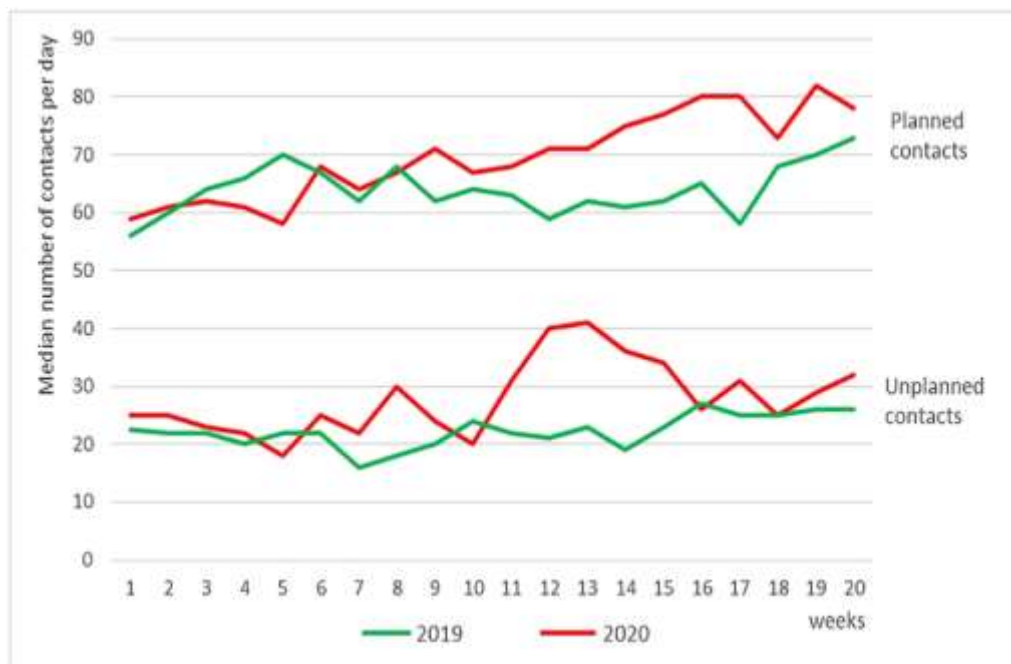


Figure 2. The number of planned and unplanned support contacts per day, over the first 20 weeks of 2020 and 2019. Source: Zaagsma et al (2020).

These findings indicate that the COVID-19 outbreak and related restrictive measures had quite an impact on the use of online support. A possible explanation for the sudden, substantial and temporary increase in unplanned online support use is that people were considerably worried and experienced a high level of anxiety especially during the first weeks of the crisis, causing more people to contact the service (more often). Several authors have pointed out that people with ID (like people without ID) are likely to experience high levels of stress and frustrations during the COVID-19 pandemic and that measures posing restrictions on their usual activities and contacts with other people further contribute to this

The consequence of marginalization of the Intellectual challenged in labour market activities

From the report of WHO and World Bank (2011), despite the fact that persons with disabilities carry a significant proportion of the world’s population, about 15%, they are rarely seen as a contributor to productive human capital

development of the Society. The World Report on Disability expressed the barriers persons with disabilities face in accessing employment as a combination of lack of access to Information Technology, vocational education and training, misconceptions about the abilities of persons with disabilities, and disability-based discrimination. The labour force inclusive rate of persons with disabilities is acknowledged as low in many countries, reflecting the numerous obstacles persons with disabilities can encounter. Report from the Office of the High Commissioner for Human Rights (OHCHR) on Employment and Disability reveals how members of the Organisation for Economic Co-operation and Development (OECD) observed that less than half of working-age persons with disabilities were economically inactive compared to one in five persons without disabilities of working age. However, it is important to note that, as persons with disabilities are not brought into focus in many of the mechanisms that account for under employment, it is difficult to estimate this figure with real accuracy. With the fact that, persons living with disabilities are not included in many countries' employment statistics as they are deemed incapable to work and therefore never counted, As a consequence of their exclusion from economic activity, persons with intellectual disability are more likely to find themselves in poverty. This condition is perpetuated by the fact that persons with disabilities are generally avoided from economic opportunities and when they are involved, they earn much less than their counterparts without disabilities, yet their cost of living (such as the costs of supporting their disability) are higher, therefore contributing to their susceptibility to poverty, and reduced the rate of achieving the sustainable development goals. This calls for the need for governments, as they advance the discussion on the goals and targets for a sustainable development framework, to ensure that investments made for implementing the sustainable development framework are inclusive of persons with intellectual disabilities.

Participants selection

Experienced computer users participated in the test of the appropriateness of the guidelines and some selected staff of Home school for handicapped children, Ijokodo, Ibadan were used. Fourt (4) participants, the educable category of students' of the school were tested. These students cannot read and write in

English Language very well but they can read and write in Yoruba Language very well.

Architecture of Image / Text Enlargement for the applications

The diagram below shows the architecture of the image / Text enlargement for the applications

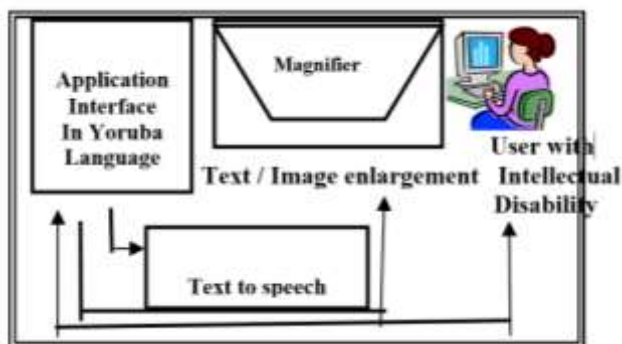


Figure 1 Architecture of Image / Text Enlargement for the applications

Basic components of the new system

The diagram below shows the entity relational diagram for the functionality of the applications for the users with intellectual disability.

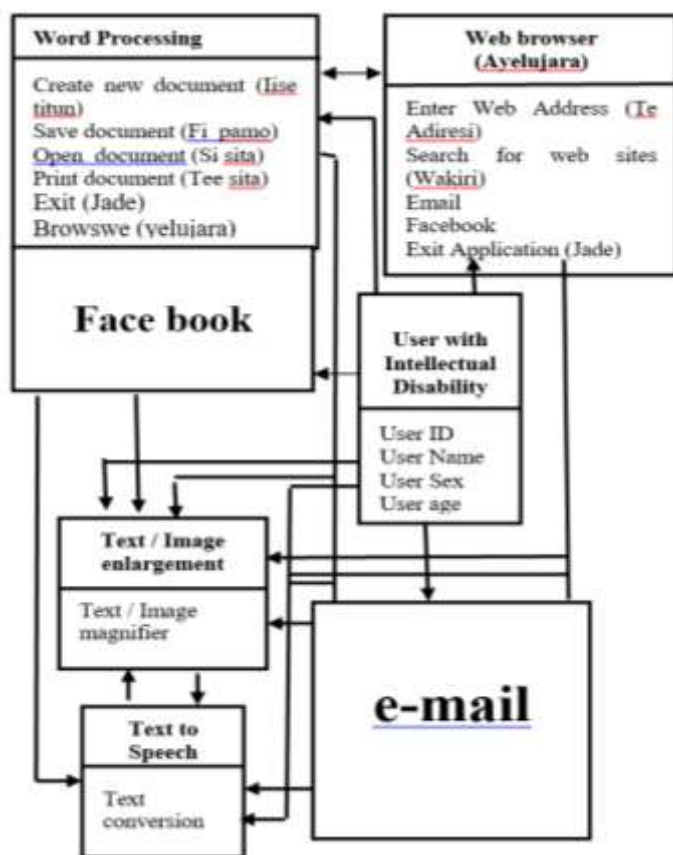


Figure 2 Basic components of the system

Implementation

Implementation is the construction of the new system and the delivery of that system into production (that is day-to-day business or organization operation). It is the process of defining how the information system should be built (i.e., physical system design), ensuring that the information system is operational and used.

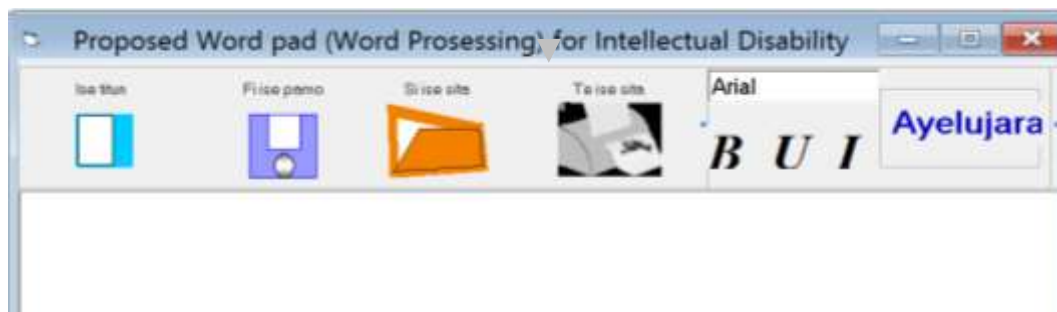


Image 1. Developed Word Pad (Word Processing) in Yoruba Language for Intellectual Disability

The simple word pad has tabs for create new document, save document, open document, print document and browser. From the browser, the user can have access to the web browser. There are also tools like bold, underline, italics and font type.

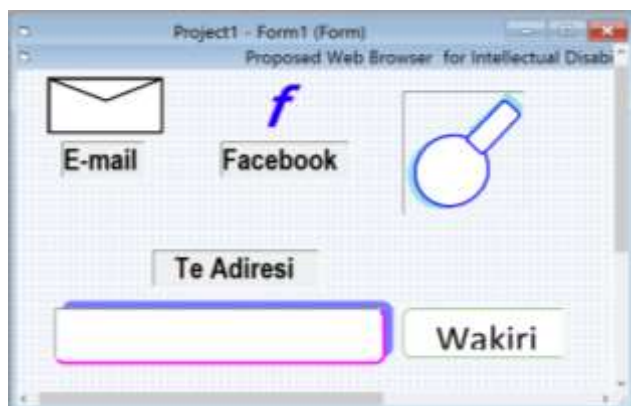


Image 2. Web Browser in Yoruba Language for Intellectual disability

The browser has a web Address (Adiresi) where the user can enter the web address to search, and search (Wakiri) tab where the user can click to start searching. It also has E-mail and Facebook tabs where the users have direct access to sign in and open e-mail and facebook respectively.

4.2 System Testing

The test was conducted with the students of Home school for handicapped children, Ijokodo, Ibadan, Oyo State, Nigeria based on the concept of

Accessible Website Content Guidelines for Users with Intellectual Disabilities, Joyce Karreman et al (2007). Parametric ANOVAs (Analysis of Variance) were applied, with the use of T-Test. The test assesses whether the means of two groups are statistically different from each other.

Results

Satisfaction with the application

The satisfaction of the participants with the versions of the applications was tested by asking them to express their opinions on a 15-item questionnaire. The mean scores of the participants were taken with the use of a rating scale. The participants used NA Application had mean score of 1.08 and the participants used A Application had the mean score of 4.95 The difference in mean score is 3.87 and the difference in the SD is 0.099. This is statistically significant. The questions were used to compare the satisfaction of the participants with the versions of the applications. The participants used A Applications expressed their 98.6% satisfaction with the applications while the participants used NA Application expressed their 78.4% frustration (Dissatisfaction) with the applications. All the Participants preferred the A Applications.

CONCLUSION

In conclusion, the usability performance metrics used to measure the performance accuracy of the system during the system testing shows that the objective of developing ICT based assistive system in Yoruba Language to promote learning ability of the Intellectually Challenged during the COVID 19 pandemic challenge have been achieved. The degree of efficiency of the system was compared with the Applications developed in English Language it recorded high efficiency.

REFERENCE

- Belkacem C. and Helen P. (2008): The evaluation of a contextual Assistant interface using cognitive models (GOMS). Journal of World Academy of science, Engineering and Technology. Sherbrooke University, Canada. pp. 752 – 759.
- Diaper D., and Sanger C. (2006): Tasks for and tasks in human–computer interaction, *Interacting with Computers* www.elsevier.com/locate/intcom, 18, pp. 117–138
- Intellectual Disability Rights Service Inc (IDRS) (2009) P.O. Box 3347, Redfern, NSW 2016, Australia www.idrs.org.au, pp. 1 – 16.
- J.C.R. Lickliders (1960) Man computer Symbiosis. Downloaded on September 6, 2009 at 23:16 from the Institute of Electrical and Electronic Engineering Xplore.
- Joyce K., Thea V. D. G. and Esmee B. (2007) edited by Ben C., Michael C., Loretta G., and Gregg V. 5th of June (2018): Web Content Accessibility Guide (WACG) for Users with

- Intellectual Disabilities, Journal of Applied Research in Intellectual Disabilities, vol. 20(6), pp. 510 – 518.
- Katz I. (2008). Intellectual disability: definition, etiological factors, classification, diagnosis, treatment and prognosis. Salud Publication Mexico. Vol. 50(2), pp. 132-141.
- Neece C., L. L. McIntyre & R. Fenning (2020): Examining the impact of COVID-19 in ethnically diverse families with young children with intellectual and developmental disabilities. Journal of Intellectual Disability Research doi: 10.1111 /jir. 12769 VOLUME64PART10 pp 739–749 OCTOBER2020.
- Neilson Norman Group (2012): User Satisfaction vs. Performance Metrics. Evidence-Based User Experience Research, Training and Consulting
- Neilson Norman Group (2001): Usability Metrics. Evidence-Based User Experience Research, Training and Consulting
- Odetunji A. O. (2008): *Recognition of Tones in Yoruba Speech: Experiments With Artificial Neural Networks*, Studies in Computational Intelligence (SCI) **83**, 23–47 (2008) www.springerlink.com
- Ojuope K. I., Adetunmbi A.O. and Oyinloye O.E. (2019): Improving Usability of the Educable of Intellectual Disability with Assistive System, University of Ibadan Journal of Science and Logics in ICT Research (UIJSLICTR), Vol. 3, No. 1, pp. 34 – 42 ©U IJSLICTR Vol. 3, No. 1 June 2019
- Ojuope K. I., Adetunmbi A.O. and Oyinloye O.E. (2019): An Assistive System for empowering persons with Intellectual Challenges for meaningful lives in the Digital Economy. A paper published in Conference proceeding of the 14th International Conference of Nigeria Computer Society on Smart Nations, Digital Economies and Meaningful Lives. July 16 to 18 2019.vo. 30(1), pp. 127 – 139.
- Ojuope K. I. and Adetunmbi A.O. (2018): Empowerment of Persons with Intellectual Challenges for sustainable Development. Conference Proceeding, 12th International multi-Conference on ICT applications (AICTTRA 2018). Organized by Obafemi Awolowo University, Ile Ife, Department of Computer science and Technology in collaboration with Africa Centre of Excellence: OAUICT Driven Knowledge Park. ISSN 2141 – 0240, Vol. 12, pp. 108 – 113.
- Shneiderman, B. & Plaisant, C. (2010). Designing the User Interface: Strategies for Effective Human-hComputer Interaction, 5th edition. Addison-Wesley. The World Wide Web Consortium (2004)(W3C), a global centre for web usability design standard
- WHO and World Bank (2011). The committee on the Right of Persons with disabilities addressed the multiple forms of discrimination face by women with disability. pp. 236.
- Zaagsma M., K.M. Volkers, E.A.K. Swart, A.P. Schippers & G. Van Hove (2020): The use of online support by people with intellectual disabilities living independently during COVID-19. Journal of Intellectual Disability Research doi: 10.1111 /jir. 12770. VOLUME64 PART10 pp 750–756 OCTOBER2020