

Visos an Assistive Computer Based Testing (CBT) in The Examination of the Visually Impaired In Nigeria

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Abstract:- The purpose of this study is to develop VISOS, an online computer-based testing platform for the examination of the visually impaired in Nigeria. The visually impaired have not been so fortunate to be reaping the benefits that come with the utilization of computer-based testing for examination in Africa and Nigeria. The mode of doing their exam has always been paper and pencil with the help of a scribe or examiner reading to them and helping them to put down their responses or the students put it down via typewriter and braille. Many pieces of literature were reviewed but narrowed down to a few contributions in Africa and Nigeria. Incorporated into VISOS are Voice recognition and Text-to-speech technology which aid the visually impaired to do the exam on their own without any assistance. An earpiece and the activated microphone of the engaged computer are needed for quality interaction.

Keywords:- Assistive Technology, Voice Recognition, Text-To-Speech, Visually Impaired Examination

I. INTRODUCTION

The disabled are in special schools where the students are engaged in learning based on their potential and ability. The needs for introduction of technology in the education of the blind cannot be overemphasized since there is a great increase in the numbers of persons affected with blindness and other visually impaired all over the world (Khan, et al., 2015). Although, the non-disabled have really enjoyed the many benefits that come from technology in education we cannot say that for the physically challenged especially the visually impaired. (Chowdary et al., 2019). Çoban et al. (2021) expressed their frustration by describing that the world is designed for the sighted because the visually impaired have a lot of hurdles to cross in their education, especially in writing exams.

The blind are faced with the task of being assessed like their sighted counterpart to determine what they have learnt over a certain determined period. Opara et al. (2015) added that the Examination/Test items are developed by the Test development and item writers of the various exam bodies in the countries for both the blind and the able in compliance with international standards. Noticeably is also that the administration of the test from the commencement of the exam process to its end is also the same with a few

differences such as the extension of time and the use of scribes (the person that reads) for the blind by an exam body like Unified Tertiary Matriculation Examination (UTME) in Nigeria.

Manoharan (2019) alleged that the current system of assessing the visually impaired has been the using of scribe to support the student throughout the exam-taking process which maybe cumbersome for the scribes. Thus, there have been the challenges of lack of scribes. Many people are not willing to be a scribe even if the requirement for recruiting them may not be so stringent in some part of the world. Therefore the students may end up with a scribe that is not reliable which can lead to mix-up and inability to matchup with their fellow students. (Khan et al., 2015).

The Bharadwaj et al. (2019) suggested that in a technological and globalized world filled with people with more aspirations in life, computer technology which is user-friendly, exact, and multitasking is an effective tool in achieving whatever goal that is specifically set by any person or organization. Thus, it will be more appropriate to adjudge computer-based testing or online examination or e-exam as a tool set out to achieve educational goals. Alabi et al. (2012) and Onyesolu and Chimaobi (2017) explained that the process of Computer-Based Testing (CBT)/e-exam/online exam is that the student reads questions from the computer screen and inputs answers to the questions via the mouse or keyboard for purpose of evaluation or assessment.

Computer-Based Testing has become a force to reckon with in examination world in both formal and non-formal setting since organizations, schools and examination boards are finding it more apt and adequate for what they want to examine. They also have seen that it advantages tremendously outweighed its shortcomings. Onyesolu and Chimaobi (2017) opined that is the reason agencies and exam bodies are using it to achieve their set out goals to the maximum. Thus, most conventional paper-based exam conducted by these examination bodies and agencies now has their replicate in a computer-based testing mode of delivery.

The visually impaired cognitive ability should also be assessed like the sighted by employing CBT platforms. In some cases where the CBT platforms were used for their assessment, they would have to still make use of a scribe who reads to them and enters the answers dictated by the candidates. This confirmed what was also observed by Khare et al. (2020) that the fear of Migrating to the CBT platform for the blind may also be a challenge since they would have to still depend on the use of scribes. Therefore there is need for a CBT platform that empowers the visually impaired to confidently do examinations without doubt on their performance.

Chowdary et al. (2019) proposed that an online Examination system for the visually challenged should be a software solution with facilities for the visually challenged students to interact with the system easily without assistance. Such a system should allow the examining bodies to input questions, administer and manage examinations on connected computer systems on the Internet or Local Area Network. Khan et al. (2015) added that the application should aid in constructing an atmosphere that affords same chances for all the students in taking up competitive exams. Naik et al. (2015) described it as an Online-Examination for visually impaired that does not overrule the rules and regulation of examination.

There have been several studies on CBT platform that accommodates the visually impaired students. Most of these platforms are from other continents in the world but few are from Africa and Nigeria. Thus, this study is on an assistive CBT platform called VISOS (Visual Impairment Students Online Examination System) that catered for the inabilities of the visually impaired so that they can write examinations on their own.

A. Statement of Problems

The sighted students have really been advantageous in all ramifications of education, especially in the aspect of assessing what they have learnt either in a short period or a long period. They are either tested by conducting a paper-based test (which is reducing drastically) or computer-based test (as a result of advances in technology) on what has been learnt. In contrast, the paper-based exam delivery mode is what is still predominant in the assessment of visually impaired students on what they learnt over time. The examination is done with the help of a scribe dictating the questions to them while the students put down the answers by themselves using braille, a typewriter or a computer or

the scribe helped to put down the answer dictated by the students to them. This examination process is costly, stressful for both the examiner and the students and time-consuming.

Thus, there should be a platform which reduces the cost implication of the exam process, lifted the examination burden from the examinees and the examiners and limit the time of administering the examination. These and more are what VISOS is out to fix.

B. Specific Objectives

➤ *The Objectives of the Study are to:*

- Develop a CBT platform that catered for the inability of the visually impaired students in writing examinations
- Develop a CBT platform that incorporated text-to-speech technology within it.
- Develop a CBT that integrated speech recognition technology within it.
- Develop a CBT platform that can be used by both visually impaired and sighted students.
- Encourage and build the confidence of the visually impaired in writing any exam.

II. LITERATURE REVIEW

Kanimozhi et al. (2017) affirmed that for the visually impaired to be involved in e-examination like normal students, there must be an innovative technology that would allow them to express their ability. The integration of the screen reader and voice interface technology with the normal CBT examination platform will help to ameliorate the problems or challenges faced by the visually impaired in e-examinations.

There have been several platforms proposed to help the visually impaired in doing examinations either on a stand-alone computer because it is a desktop application such as was seen in the study by Vats et al. (2016) or over a network/internet because its web-based as found in Breja, (2015), Naik et al. (2015), Onyesolu and Chiomaobi (2017), Azeta and Daramola (2017) and Osewa, and Bibu (2019) among others.

As most studies were done outside Nigeria the study narrowed down on the studies done in Nigeria. However, some of the foreign works reviewed are:

Table 1: Showing Literature Reviewed Outside Nigeria

Proposed Study	Types of Input and Output	Authors
Online Examination System for Blinds	Voice as output and limited keyboard as input	Shanmuga et al. (2014)
E-blind examination system	Voice as output and output	Naik et al. (2015)
Voice operated tool-examination portal for blind persons	Voice as output and output	Vats et al. (2016)
Online examination for visually challenged people	Voice as output and limited keyboard as input	Kanimozhi et al. (2017)
E-blind exam portal	Voice as output and Input	Bharadwaj et al. (2019)
Voice based online examination for physically challenged	voice	Khan et al. (2015)
Computerized examination for visually impaired students	Voice as input but keyboard as output	Deepika et al. (2017).
Voice Recognition and its Application in online exam for P.H People	Voice as input only	Jamunkar et al. (2014).

A. In Nigeria, Some Studies Carries Out were:

➤ Chukwuemeka et al. (2021)

In a paper titled "Development of an Examination Based System for the Visually Impaired Persons" in which they developed a voice-based desktop application examination platform using voice synthesiser, photonic analyzer, and filters techniques technology to enable visually impaired students to write exams without the assistance of scribes. The system was built with universal modeling diagrams, MYSQL, and the Visual Studio tool. They said that using an earphone decreased the noise they encountered while testing.

➤ Zeta et al. (2017)

Study titled "Developing e-examination voice interface for visually impaired students in open and distance learning context," where they proposed a framework for guiding the development of voice-based online examination for visually impaired in Open and Distance Learning (ODL) because they assumed previous studies lacked adequate assessment quality. The technologies included in the planned development were system design, server side scripting, voice-based system development, data administration, and rule-based reasoning. On a usability scale of 5, the platform's 'average usability' result value was 3.48. They claimed that this platform would provide better quality accessibility to visually impaired students who wanted to take exams on the ODL platform.

➤ "CBT Plug-in:

Towards Inclusive Computer-Based Testing for the Visually Impaired" by Osewa and Bibu (2019). A CBT plug-in that was purported to work with any CBT platform that was available was developed with the goal of including both sighted and visually impaired in the same examination environment, eliminating scribes, suppressing the noise created by voice input, and lowering the cost of testing blind students. The plug-in can read aloud the questions and options to the candidates via a Speech Application Programming Interface (SAPI), but it can only receive responses via the computer's limited customizable keyboards. The system undergoes usability evaluation twice. The first phase included eight targeted consumers, the findings of which were used to make improvements to the

prototype before the second phase of testing. According to the data, users were pleased with user logins, the convenience of selecting keys on the keyboard, examination instructional materials, and the suitability of exam time. Finally, Osewa and Bibu (2019) concluded that scribes would no longer be in use.

➤ Onyesolu and Chimaobi (2017)

Study titled "Design and Implementation of JAMB Computer-Based Test System with Voice Command" spurred by a desire to see the visually impaired take the UTME exam on their own. They created a CBT system that allows the visually impaired to take exams like their peers by speaking their replies after the questions and options are read aloud and controlling the activities with their voice rather than a mouse or keyboard. Object oriented analysis and design methodology (OOADM) were employed in the system's design and implementation. According to the conclusions of this study, using this platform will improve the performance of visually impaired people.

III. PROPOSED PLATFORM

VISOS is a web-based online examination system that allows visually impaired or sighted students to access exams through the internet or intranet using computer systems. It was developed using PHP - (Hypertext Pre-processor), Google automatic speech recognition (ASR), Google speech service and MySQL as the database.

A. Overview of Speech Recognition Process

Speech recognition procedures include feature extraction, acoustic modeling, pronunciation modelling, and decoding. The end user interacts with the application by utilising a suitable input device, such as a microphone. Because sound waves travel in the form of analogue signals, the recognizer first takes them as analogue signals and then transforms them to digital signals. Speech signals are then translated to electrical impulses. Feature extraction removes numerous sources of information, such as pitch periodicity, amplitude of excitation signal, and fundamental frequency, among many others. The decoder makes the real judgement regarding speech recognition by merging and optimizing information. This is as shown in Figure 1.

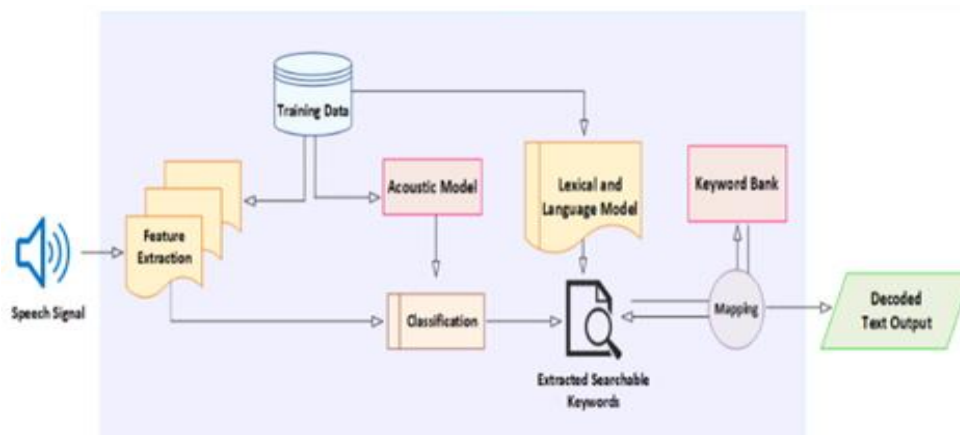


Fig 1 Speech recognition Process Model for the Assistive CBT

Google Automated Speech Recognition (ASR) is a form of ASR that converts speech to text using an API powered by the best of Google's AI research and technology.

➤ Speech Service

The ability of a device or computer to convert orthographic text into speech without the assistance of a human is referred to as speech synthesis (Mihkla, 2007). The Text-To-Speech System (TTS) is a computer-based system that turns text into simulated human speech automatically. That is, it can read aloud any text, whether it was typed into the computer manually or scanned and uploaded to an Optical Character Recognition (OCR) system. 1997 (Dutoit). Additionally, text-to-speech synthesis (TTS) can be defined specifically as an automated procedure that turns unrestricted natural language written phrases into spoken versions that closely resemble the spoken versions of the same texts by a native speaker of the language.

It carried out this operation by analyzing and processing the text using Natural Language Processing (NLP) and then converting this processed text into a synthesized speech representation of the text using Digital Signal Processing (DSP) technology (Isewon, et al., 2014) as represented in figure 2

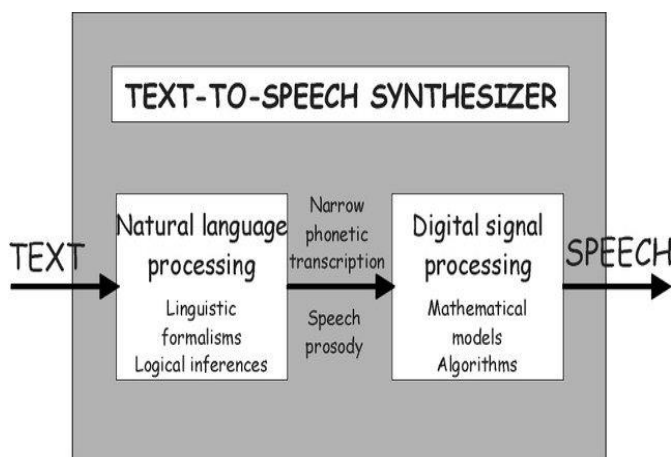


Fig 2 Generalized Text-to-Speech Synthesis Model (Adapted from Mihkl, 2007, modeling speech temporal structure for Estonian text-to-speech synthesis).

Figure 2 depicts a simplified depiction of the physiological reading process using a computer-imitated TTS system. A TTS synthesizer, like a human reader, has a natural speech processing module that translates the input text with the desired intonation and speech rhythm into the output text. The digital signal processing module turns the incoming text's symbol data into natural-sounding speech. The natural speech processing module gives the text a phonetic description and determines the speech prosody. Text processing is often described at various levels: phonetics, phonology, morphology, syntax, and semantics. A screen reader program for its Android operating system is Google Speech Services. It enables program to speak (read out) text displayed on screens in a number of different languages.

B. Overview Of The VISOS Operation

The Google Speech Service and Automatic Speech Recognition (ASR) provided a Text-to-Speech and Speech-to-Text technology service in the platform, respectively. The questions on the screen can be read aloud using the Google speech service, and the selected options from A to D can be recorded using Google automated speech recognition (ASR). These embedded technologies can access the exam database's questions and the storage for answers. The headphone/earpiece/headset connected to the computer system, as shown in figure 3 creates the interface between the student and the system. In other words, the exam is attempted and responded to by the system reading out the test questions and the students replying to it by saying the option to the headset from the start to the end of the allocated time for the test.

The students were individually registered using the provided registration forms, and for each student, a unique examination number was generated. This number was used to log in to the platform and attempt the course(s) or subject(s) for which the student had registered. The examiner who is not blind does the login process. The admin/examiner determines the exam length and time, and the questions for each subject or course are pre-loaded using the given excel template. The final result is reported.

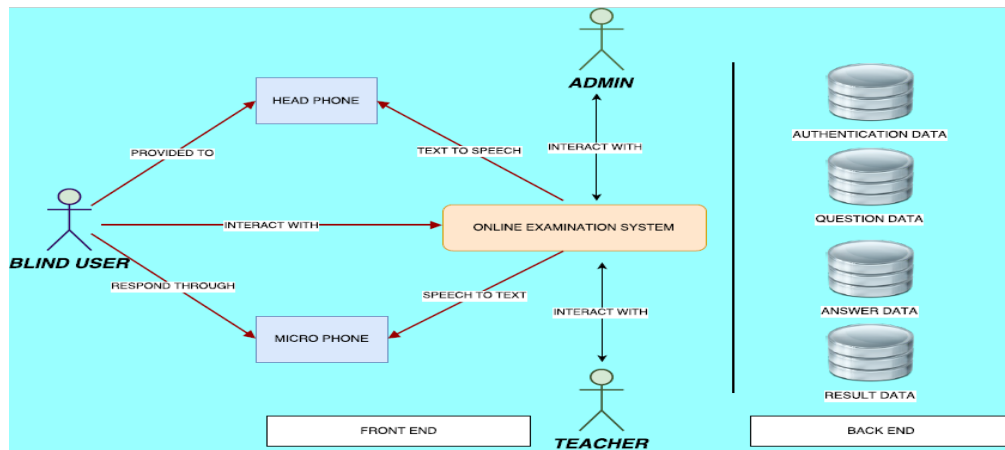


Fig 3 Assistive CBT Model
(Adapted from Thajun and Samsudee, 2021)

The platform has two parts: the Admin and Student part. Each of the part has its own different module.

➤ **Admin Module:**

- Login
- Exam Scheduler and Question Bank
- Exam Question Template
- Upload Eligible Student
- Add Course
- Upload Question
- Exam Results
- Delete Submitted Answers
- Find Exam Result

➤ **Student Module:**

- Login
- Exam Question

C. Operations of VISIOS

The administrator/examiner logs in to create a subject(s)/course(s). He/she enrolls students in the generated subject(s)/course(s) using the unique downloaded excel sheet template or CSV file, uploads the questions, and sets the timing and duration of the exams/tests using the unique downloaded excel sheet template or CSV file. The invigilator assists visually impaired students in logging in

using a generated number and their surnames, as well as activating the speaker and microphone. Alternatively, by not enabling the computer's microphone or speaker, the same platform can be used for able bodies' exams.

The visually impaired candidate interacts with the system via any earphone or headset. Immediately, the student login, the system says "Welcome 'Studentname', read instructions of the exam to him/her and it moves to the first question. The computer reads the question and its possibilities A, B, C, D to the learner, then asks him to choose his response by saying "Answer 'option'". The system asks "is option your final answer?", the student replies "Yes" and the system states "'option' submitted". The student says "load question 'number'" or "read question 'number'" or "Next question" to proceed to the next question. This process continues until the last question and the system prompts "You are on the last question". If the examinee is still within the time limit for the test, the system will prompt "do you wish to submit all your answers" after the last question is submitted else the system submit the full answers and log the student out saying "You have exceeded the time limit and your exam is finished". The model is shown in figure.

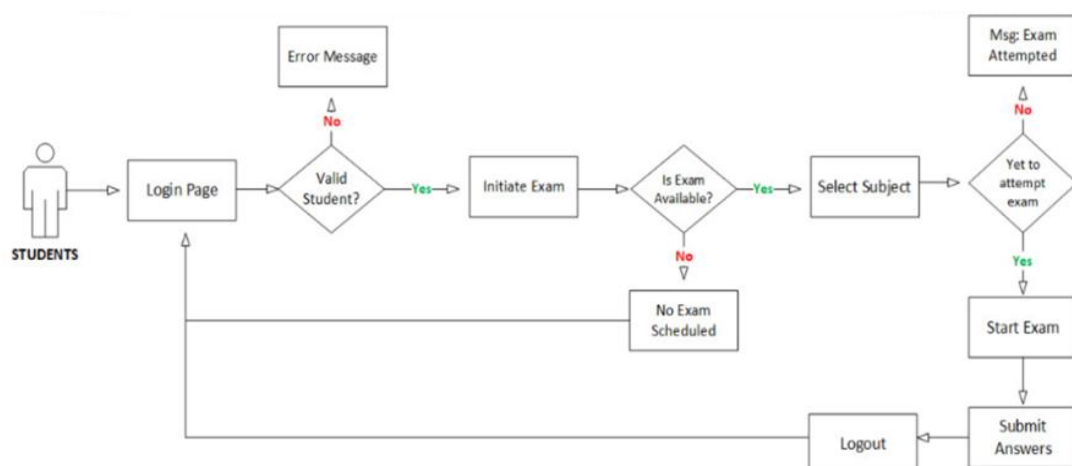


Fig 4 Operational Flowchart Model for the Examinees

The administrator/Examiner can obtain all of the results in whatever format he wants from the accessible formats, which include pdf, excel, and csv files. A student can only take a course/subject exam once. As a result, unless the administrator grants permission, the student will not be permitted to retake the exam.

➤ Current System

Scribe reads each question → candidates listened → Scribe asks the Candidates to supply answer → Scribe moves to next question → Exam ends when questions are exhausted.

➤ New system

Automated Scribe reads each question → candidate listened → Automated Scribe asks the Candidate to supply answer → Automated Scribe moves to next question → Exam ends when questions are exhausted.

➤ Screenshot of Student Login

From the Landing page of student, the invigilator click “Get started button” or Exam portal and the student is routed to the Exam Login Portal.

The student/invigilator supplies the Examination Number and Surname in the available boxes respectively and click on proceed button as shown in figure 5. The page that shows the enrolled subject(s) comes up and the student/invigilator clicks on “Take exam” to proceed to exam portal as shown in figure 6.

Fig 5 Screenshot of the sample of the Student Login page.

Fig 6 Screenshot of the Sample of the Subjects Enrolled for the Student

Fig 7 Screenshot of the Sample of the Passive Exam Portal for the Student

Fig 8 Screenshot of the Sample of the Active Exam Portal for the Student.

The test instructions are read to the blind student via the earpiece as soon as the exam portal opens, and the student enters the answer using the same device as shown in figure 7 & 8. The system notifies you that you are attempting the final question whenever it is about to be attempted. The system will either log the student out when the allotted time has passed as shown in figure 9, or the student must complete the test within that time. The system reads out the remaining time if the student is still on schedule, so that he/she knows how much time is left for the test. When a student says submit button after finishing the task on time, the system asks if they want to submit all of their answers and log out. If YES the system responds by saying all option have been submitted successfully and you have now been logged out of the system.

Fig 9 Screenshot of the Sample of the Active Exam Portal for the Student

IV. CONCLUSION

VISOS an examination portal for the blind was developed and tested by the intended users. VISOS is a highly interactive examination platform that boosts the blind students' confidence and produces such enthusiasm that could affect their performance positively. The platform functions were basically controlled by the human voice interacting with it during examination with the help of earpiece to prevent any unwanted noise such that the voice of the examinee alone was captured. Fluctuation in the internet service was one of the major challenges encountered during the testing of the platform. Thus, strong internet connectivity is advised to make VISOS perform optimally.

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