DEVELOPMENT OF A VOICE-BASED ELECTRONIC EXAMINATION FOR STUDENTS WITH VISUAL IMPAIRMENTS

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Abstract

Assessment is regarded as one of the key components of learning. Therefore, it is mandatory for students in different schools to be accessed before they can be promoted. Nowadays, most assessment are now completed on computers using online or locally connected computer-based exams. In order to swiftly and accurately offer answers using computers, students must possess the skills necessary for proper computer use. However, due to limitation and difficulties in operating a computer keyboard with several number of keys, visually impaired students have trouble operating computers. Voice input technology provides a range of devices and software that are capable of responding to human voices. Voice-based system allows visually impaired students to navigate exam questions using voice instructions. In this paper work, we presented a Voice-Based Electronic-Examination System that aims at reducing the challenges faced by students with visual impairments in taking examination. We have developed a prototype of the system using React JS and Node JS for building the web application. The software system was coded with React JS for the frontend and Node JS for the Backend. Similarly, the database was designed using MySQL database management system.
KEYWORDS: Assessment, voice-based, visually impaired-Examination.

Introduction

Globally, there has been an alarming increase in the number of students who are experiencing visual impairments (Hasselbring & Glaser, 2000). Global figures show that one child becomes blind nearly every minute, for a total of 500,000 children becoming blind each year (World Health Organisation-WHO, 2012). There are more than 485,500 school-aged children who are blind just in the United States of America. The situation is the same in Africa, particularly given the HIV/AIDS pandemic, which has brought about an increase in the number of people living with visual impairment. Computers connected to the internet or local server are used nowadays to write exams. Hence, students must have the capability to use computers efficiently in order to provide answers via computers accurately (Hidayat et al,2021). However, due to eyesight restrictions and difficulty utilizing a computer keyboard with a large number of keys, visually handicapped pupils have trouble using computers. They could adopt a specialized computer that is loaded with specific software to change text on a monitor screen to voice.

Assistive technology (AT)has immensely been used to assist pupils with visual impairment in their day to day activities. Assisitive technology refers to any device ,software or system that is used to assist an individual who has some form of disability or impairment. Futhermore,in the context of education and assessment ,some of the assistive devices include braille note takers, eye-tracking technology, scanning and reading pens, magnification software and equipment and generic AT (for example, tablets and digital recorders).Furthermore, the United Nations Educational, Scientific, and Cultural Organization, or UNESCO (2008), encourages blind or visually impaired students to use assistive technology because it believe that advancements in technology can help level the playing field for people with vision impairments. European Union (2002) emphasized that use of ICTs has developed into a potent tool for education because it gives visually impaired students the chance to access a wide range of resources and information that will allow them to share their ideas and thoughts with others in group learning settings. For instance, the majority of blind students today can use paperless Braille machines, talking calculators, and tape-recorded books and classes for academic purposes (Kiambati, 2015; Gogate, Kalua, &Courtright, 2009).

In a bid to mitigate these challenges, software developers have created a number of assistive technology software tools (UNESCO, 2008). For example, Job Access with Speech (JAWS) is a computer program created for users whose vision impairment prohibits them from viewing the content on the screen. The text that is displayed on the computer screen is read aloud by JAWS. It is compatible with the Microsoft Office Suite and other widely-used programs we use on a daily basis. Windows Eyes, a well-known program for the blind and visually handicapped, is another program created for the same goal. It turns components of the Windows operating system into synthesized voice to provide access to

Windows-based computer systems. Other tools for the same purpose include Non-Visual Desk and Dolphin Super Nova, a screen reader that communicates through a refreshable Braille display or a speech synthesizer while reading the screen interactively. Examples include Thunder, a free screen reader for those with little or no vision (Dolphin Computer Access, 2017), which enables people who are blind or vision-impaired to utilize computers. Freire et al (2009) higlighted the challenges faced by the visually challenged students while using the e-learning technologies and emphasized that many of those platforms were impractical for them. Salleha (2010) examined the social behaviors of students with visually impairment together with the issues which are missing in their education. In his research, Yurtay (2011) proposed a system that would use voice synthesis technology to enable visually impaired students to take advantage of the benefits of the university library. A technology created by Junying (2012) allows people who are blind to take exams on a platform. For the benefit of students who are blind or visually impaired, Ozgur (2007) created an audiobook version of numerous books from the university library. Nilufer et al (2015) reiterate that visually impaired students must learn the procedure related to meeting their day-today personal needs. The important chores of such training start from the simple task such eating techniques, shining shoes, cleaning, ironing, eating and cooking techniques.

In this paper, we have developed a voice-based Electronic Examination system that will allow visually impaired individuals to take assessment with ease and convenience. The software system provides a platform for visually impaired pupils to be authenticated via the voice and also take the assessment using the voice input.
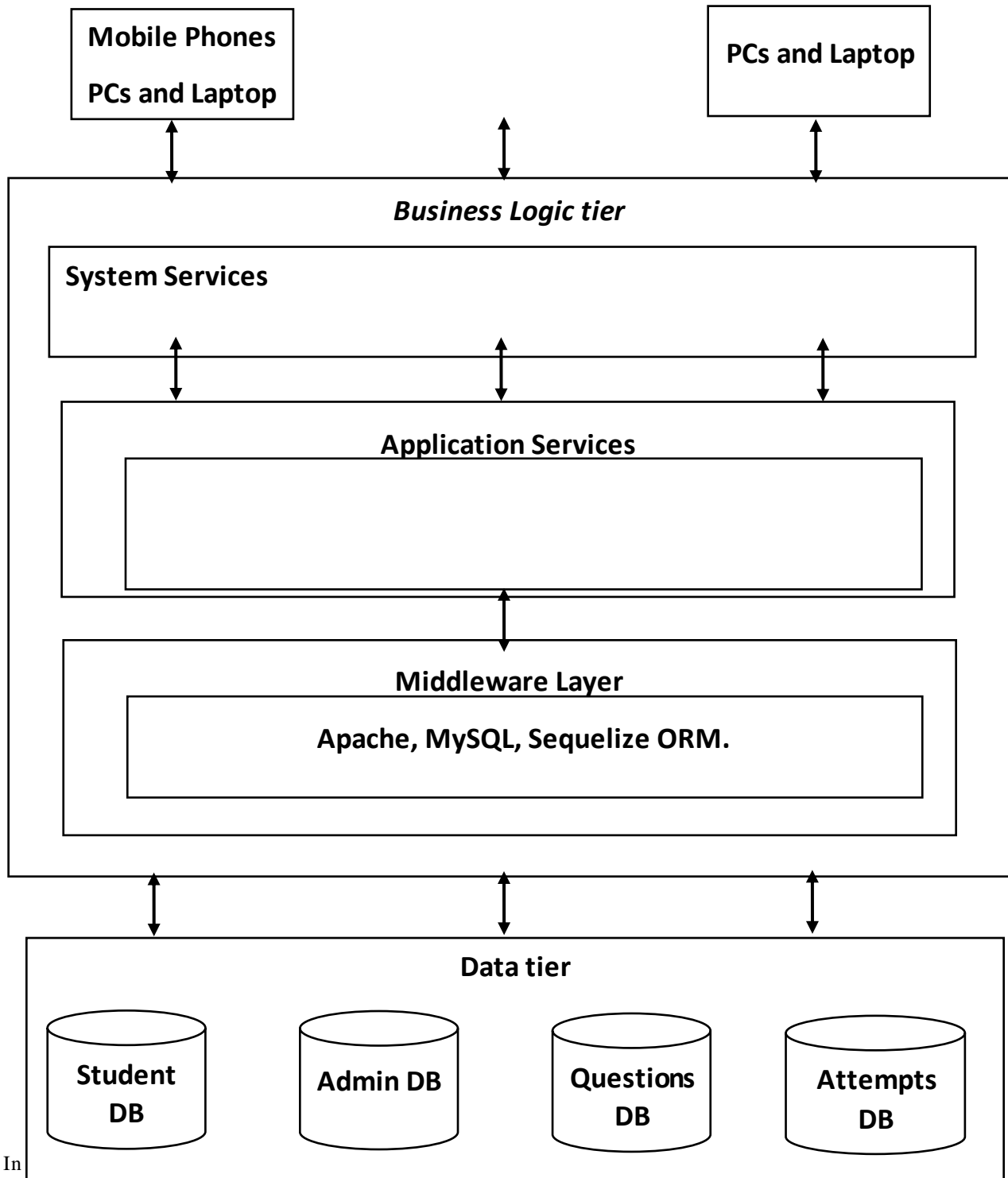
Hidayat et al (2021) designed and implemented an electronic examination device for blind as solution to access a computer in a friendly manner. The system's two main components include an exam monitoring program and a device for blind pupils. The student device contains push buttons for entering braille code and a text-to-speech application to help students during exams. However, the components of the examination monitoring application assist in recording user identity and test-taker responses from blind candidates. Six pushbuttons were employed as braille codes on the student gadget, which also had five pushbuttons for navigation. Raspberry Pi served as the device's data processor. A text-to-speech conversion program is also included. The registration of the examinees, the administration of the exam, and other processes are handled by the examination monitoring application.

Thajun (2021) developed a voice-based online examination system for visually impaired students in Open distance learning (ODL) with voice based assistive technologies. The proposed system is used to conduct the examination via a user-friendly Voice Interface. Students can answer via voice and the student's answer will be evaluated against the correct answer which is stored in the database in real-time also the given answers will be stored in the database
A voice-based test was created for open distance learning (ODL) by Azetal et al. (2018). The authors produced an expert voice-based e-examination system for ODL that shows students how exam questions are shuffled. The study uses a variety of technologies, including rule-based reasoning, server-side scripting, voice-based system development, data management, and system design and modelling using the Unified Modelling Language (UML), to create a prototype voice-based e-examination expert system for ODL. To ascertain the system's performance

Methodology

SYSTEM DESIGN
This depicts the procedure for the development of different components of a software system, including its modules, architecture, and components, together with its interfaces and the data it processes. With respect to the requirements and detailed analysis of a new system, a new software system is designed. The design stage is one of the most crucial parts of the software development process. This is due to the fact that the design of any software system determines its success. In this phase, the user's specification is used to translate the model into the design of the proposed system. Similarly, at this level, module definitions and their relationships with one another is explicitly stated. System design ensures that a particular software system meets up with the requirements gathered at the analysis stage.

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In
Application Module, Middle Layer, and Data Tier. Let's discuss each of these components and their role in the overall architecture.

Business Logic Tier: The Business Logic tier contains the core logic and rules of the application. It handles the processing and manipulation of data, as well as the implementation of business-specific functionality. In this project, the Business Logic tier would include functionalities like student registration and login, admin login, questions upload, examination management, and result interface. It ensures that the application's business requirements are met and enforces appropriate validation and security measures.

System Services: System Services are responsible for providing underlying infrastructure services to the application. These services typically include authentication, authorization, logging, caching, and error handling. In the given project, the System Services might include components such as user authentication and authorization services for student and admin logins, logging mechanisms to track system activities, and error handling modules to capture and report any exceptions that occur during the application's execution.

Application Module: The Application Module represents the specific modules or components of the application that deliver the required functionalities. In this project, the Application Module can be further divided into sub-modules such as student registration module, login module, question upload module, examination module, and result interface module. Each module focuses on a specific set of tasks and collaborates with the Business Logic tier to implement the desired functionality.

Middle Layer: The Middle Layer acts as an intermediary between the application and the data tier. It facilitates communication, data retrieval, and data manipulation between the application and the data tier. In the given project, the Middle Layer might include components such as Apache, MySQL, and Sequelize ORM. Apache can serve as a web server, handling HTTP requests and directing them to the appropriate application modules. MySQL can be used as a relational database management system to store and retrieve data related to student records, admin details, questions, and examination attempts. Sequelize ORM can provide an object-oriented interface for interacting with the database, simplifying data access and manipulation.

Data Tier: The Data Tier represents the storage and retrieval of data used by the application. In this project, the Data Tier can consist of separate databases for different entities, such as STUDENT DB, ADMIN DB, QUESTIONS DB, and Attempt DB. The STUDENT DB can store student information, the ADMIN DB can store admin-related data, the QUESTIONS DB can store the uploaded questions, and the Attempt DB can store the records of student attempts in the examination.

ENTITY RELATIONSHIP DIAGRAM (ERD)

Entity Relationship Diagram, or ER Diagram for short, is a diagram that shows the relationships between entity sets that are stored in a database. To put it another way, ER diagrams assist in describing the logical organization of databases. Entities, attributes, and relationships are the three fundamental ideas that serve as the foundation for ER diagrams.
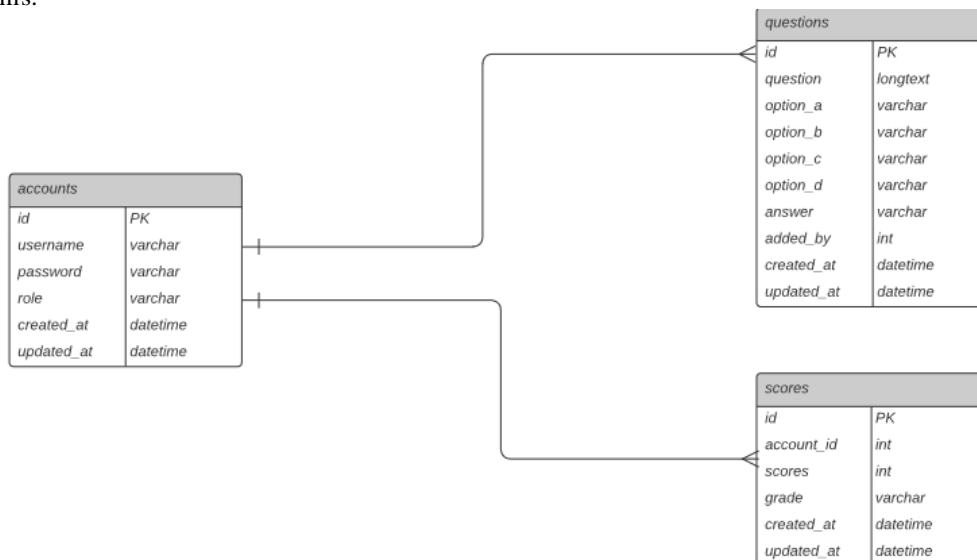

Figure2.2 Entity relationship diagram

 Result

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The result indicates a comprehensive analysis of the results obtained from the voice-based e-exam. The voice-based exam system was designed to revolutionize the traditional examination process by leveraging cutting-edge speech recognition technology.

Discussion of result

THE HOME PAGE
In this part of the system, user's sign in with their already registered details to gain access to the dashboard. The username and password can be entered through the mic. The user can login to his account in this page by providing the correct details. The user is taken to the home page after entering his unique username and password and clicking the log in button. If a new user wishes to create an account, he must first click the sign-up button before being taken to the registration page. In a similar vein, users can access the software system by using voice recognition.

Fig 4.1 Home page   **User registration component:**
Users can sign up into the platform here by filling up their username, password and a password confirmation

Fig 4.2 User's sign in page
User Dashboard Index Component:
As soon as users' get logged in successfully, they are brought to the dashboard index.
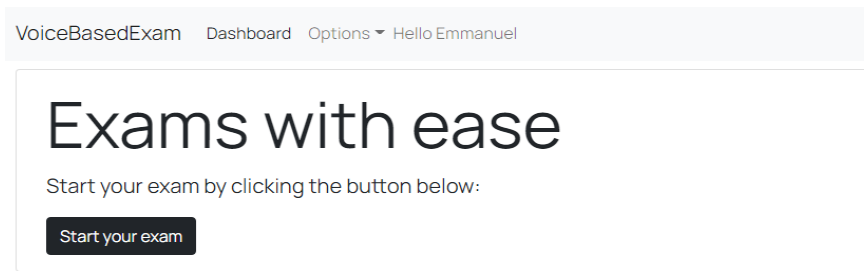
Fig 4.3 User dashboard

Quiz Component:

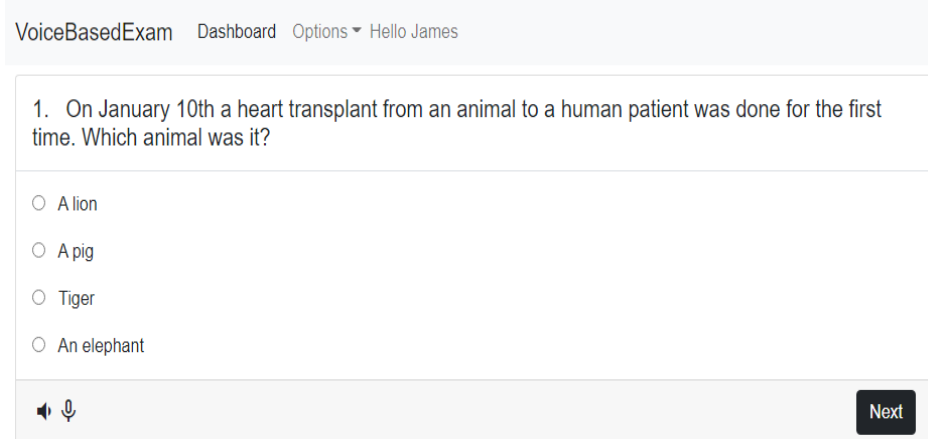This part of the app is where authorized users can access to answer some randomized quiz questions.

Fig 4.4 Quiz page

ADMNISTRATOR'S LOGIN PAGE

Here, the administrator of the quiz application logs in by providing the username and password.

Fig 4.5 Administrator Login page

ADMINISTRATOR DASHBOARD INDEX:

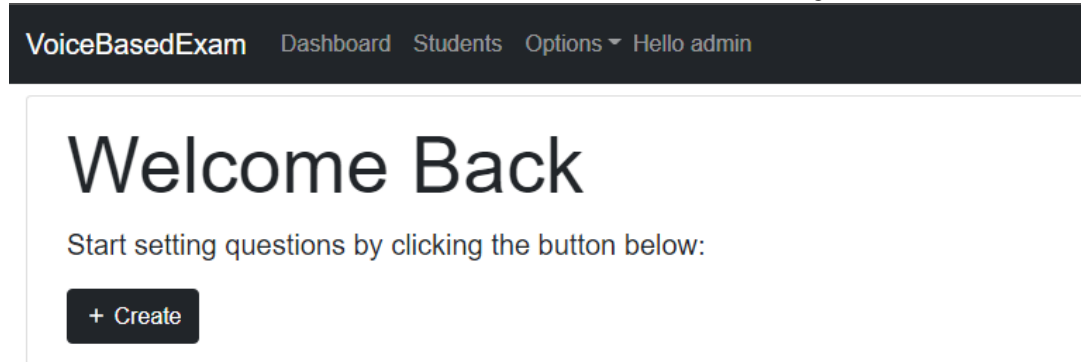The administrator is redirected to the dashboard index after a successful login.

Fig 4.6 Administrator dashboard

Create and view questions component:

In this component, the admin creates questions with four options including the right answer. Once created, they are added to the list of questions below the create question form.
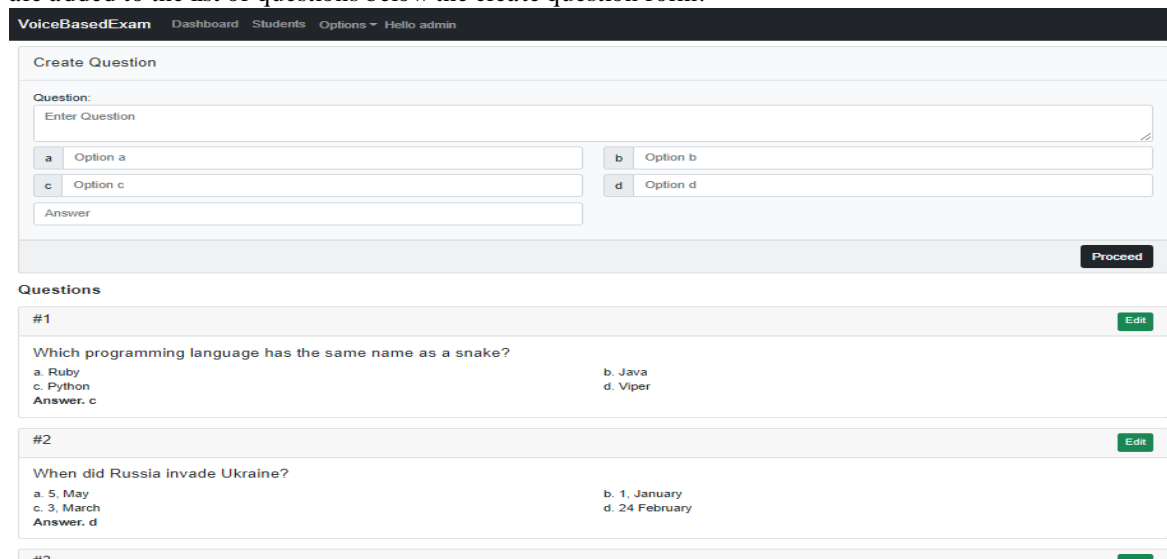

Figure 4.7 Create exam page

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Students' component:

All the registered students are viewed on this component

Figure 4.8 Student's list page

The scores and the grades of the attempts that the student has made is revealed here.

Figure 4.9 Students attempts page

Conclusion

In this paper, the development of a voice-based E-Examination was carried out to relieve the visually impaired students the rigor of using the traditional paper-based assessments with the use of software system and good product design which accomplish most of the user's requirement. The methodology adopted includes consultation with the school administrators, teachers, pupils and others stakeholders on the field. Other methods of information gathering includes, surfing the internet, and review of relevant literatures. The system was aimed at delivering examination to visually impaired pupils in primary school. The project was implemented using React JS, Express JS and Node JS. Furthermore, the newly designed system used MySQL for database and the end product was deployed on Heroku cloud platform.

n future research work, it is possible to add other features to the system, such as the integration of the software to an internet of things (IOT) device and an email module that can send student result to their parent via a voice command.

References

Dolphin Computer Access (2017). Software for the blind. Worcester, UK. Retrieved June 11, 2023. From https://www.yourdolphin.com.

Hasselbring, T. S., & Williams Glaser, C. H. (2000). Use of computer technology to help students with special needs. *The Future of Children, 10*(2), 102–122. https://doi.org/10.2307/1602691

Hidyat H, Nanra S ,Hasibuan ,Mochamad F ,Wicakosono .(2021) .Design and Implementation of Electronic Examination device for improving the blind students' comfort. Journal of Engineering Science and Technology Vol. 16, No. 1 (2021) 807 – 815

Nilufer Yurtaya, Yuksel Yurtaya, M. Fatih Adaka (2015). An Education Portal for Visually Impaired Procedia - Social and Behavioral Sciences 171 (2015) 1097 – 1105

Ozgur, A. Z., ,Kiray, H.S.(2007) "Evaluating Audio Books as Supported Course Materials in Distance Learning: The Experiences Of The Blind Learners", The Turkish Online Journal Of Educational Technology – TOJET, ISSN: 1303-6521

Salleha, N. M., Zainalb, K., (2010). "How And Why the Visually impaired Students Socially Behave The Way They Do", Procedia Social and Behavioral Sciences, Volume 9, (pp. 859–863).

Thajun Najaah M.A Samsudeen Thowfeek Ahamed (2021) Voice-Based Online Examination System For Visually Impaired. Journal Of Management Vol. 16, Issue. 1, April, 2021 Issn: 1391-8230 27-38

Yurtay, N., Bicil, Y., Çelebi, S., Çit, G., Dural, D., (2011). "Library Automation Design For Visually Impaired People", TOJET: The Turkish Online Journal of Educational Technology, Volume 10, Issue 4, (pp. 255-260).