Android-Based Examination Questions Reader Application for Visually Impaired Students

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Abstract: Education is part and parcel of every human being. Education empowers an induvial, concocts a community, and protrudes a nation. To be educated, a person must gain knowledge through reading, listening, speaking, and writing. These processes are carried out through our body parts. Body parts such as the brain, heart, eyes, ears, mouth, hands, etc., play an important role in education. When any such body parts get affected, it will affect the entire system. Those people need extra guidance and support. As such, visually impaired students cannot read question papers during the examination as their sense of vision is deformed which can cause a lot of difficulties during their exam period including diverting the attention of the examiner to get special consideration or attention. However, a screen reading application can help impaired students to be independent in writing the exam. This project aims to address this problem by developing an Android application that has the capability of reading out questions to visually impaired students during examinations. To make the students independent in the examination hall in terms of perceiving questions. Moreover, the application can only work on mobile devices supported by the Android operating system. The Application`s reading capability is limited to questions written inEnglishlanguageonlyanditcannotreadtablesnordescribefigures.Inthecourseofthesoftwaredevelopment, this project has adhered to software Engineering principles where an iterative model was chosen as the SDLC approach to be used for the system development. After the system was fully implemented, a Beta version of the application was subjected to testing where informative feedback was obtained from testers and necessary changes were affected.

Keywords: Visual Impairment, Android operating system, Android Application, Examination question reader

Nomenclature

Abbreviation	Expansion
WHO	World Health Organization
SMS	Short Message Services
YPAB	Foundation for Blind Handicapped Persons
CNN	Convolutional Neural Network
IPA	Interpretative Phenomenological Analysis
OCR	Optical Character Recognition
DVM	Dalvik Virtual Machine
ER	Entity relationship
OS	Operating System

1. Introduction

According to WHO defines blindness as visual sharpness of less than 3/60, or a corresponding visual field loss to less than 10degrees in the better eye, even with the best possible sight alteration [1]. A gift is as valuable as a good vision. Not everybody has the good fortune to appreciate this. They occasionally reveal themselves to be blind or, worse still, to have a weak vision. An estimated 253 million individuals world wide suffer from vision impairment. According to the WHO, moderate to severe vision impairment affects 217 million people, leaving 36 million people legally blind [18].

Smartphone turns to be part of our daily life nowadays. A person can hardly spend a whole day without using his Smartphone. Moreover, this sophisticated invention has transformed how we use to carry out our daily activities ranging from academic activities, business, way of life, etc. This is due to its

portability, versatility, affordability, and mobility. A mobile application by nature is easier to use andaccessinformationandthisrequisiteencouragedtheneedforandroidbasedexamination reader for visually impaired students.

Android is a mobile operating system made for touch-screen a device that is based on the Linux kernel. Google serves as the primary contributor to the Open Hand set Alliance [2] a group of developers who work to get her to build and support Android. Since it is open-source software, a significant portion of devices with arrange of prices use it. However, the OS's popularity is constrained by the fact that it is primarily made for touch-screen gadgets. These gadgets use a GUI with a capacitance screen to recognize gestures and respond appropriately. Visually challenged individuals must overcome this significant obstacle because It renders the GUI utterly worthless to them. Without a GUI, simple tasks like making a call or sending a message becomes difficult because it is impossible to know the device's feedback.

However, in this era of mobile technology, most of our work depends on smart phones and their applications. Mobile applications provide lucid solutions to many of day-to-day activities such as booking online appointments, buying and selling, and many more [3]. Visually impaired people confront several visual challenges every day – from reading the label on a frozen dinner to figuring out if they're at the right bus stop [1]. Probable solutions include Braille where in tactile information is converted into meaningful patterns. Other visual aids include liquid level indicators, coin sorters, large button telephones for daily living; electronic magnifiers, audio books, text to voice technology as a technological aid.

Moreover, Independent life is vital in today's world, but blind individuals are severely constrained [4] Since they require manual assistance to learn about their surroundings is a great disadvantage. Many tasks are founded on visual information. Therefore, the majority of daily tasks are challenging for blind persons to do. Technology developments have made it possible to help the blind. Today, a large portion of our everyday lives are spent using mobile gadgets, also referred to as portable smart devices. These tools are excellent for supporting and easing the lives of those with vision impairments. Speech and written information are the major components of human communication [5]. A person must have a vision to view text-based information. Those without vision are unable to access text-based information. One must be able to speak to express information. Those who cannot talk are unable to communicate their ideas. Thus, rapid technological advancement can make life for those with disabilities easier.

In this paper, we proposed the development of an Android-based examination question reader application for visually impaired students. The methodology used in the development of the application is the iterative model of software development. In the iterative model, the software is first developed on a small scale, and then more features and modules are added to the software in each subsequent iteration. As a result, an fully functional Android application was developed to read out questions to visually impaired students.

The paper is organized as follows: Section 2 represents the literature review, Section 3 provides the methodology, Section 4 represents the overview of the system, Section 5 represents the flowchart,

Section 6 demonstrates the use case diagram, section 7 includes the Entity Relationship Diagram, section 8 represents the system implementation and testing, section 9 explains the advantages and disadvantages, section 10 mentions the result and discussion, section 11 includes the testing, section 12represents the summary, section 13 provides the conclusion, and section 14 explains the future work.

2. Literature Review

This paper [2] adopted a system that facilitates reading for a blind person. With the help of the system, they extracted text from images using google cloud vision API. The approach was capable of recognizing text in various challenging conditions where traditional OCR systems fail; in the presence of blur, low resolution, low contrast, high image noise, and distortions. The output text was converted into audio output in the form of synthetic speech. [6] Explains that the senses of humans interact with the world. The human brain incorporates into a meaningful whole the fireworks of the neurons of seeing, hearing, feeling, tasting, and touching. But when an organ stops functioning, we don't worry about our senses. There are five senses for human beings: eyes to see, tongue to taste, nose to smell, ears to hear, and skin to touch. The most important sensory organs are our eyes, by far. Using our sight, we interpret up to 80% of all experiences. And if different senses quit functioning such as style or odor it is the eyes that fantastic shield us from risk. But sadly, not everyone is rewarded with a sense of sight. As there were about 285million visually impaired people in the world up until a few years ago, a figure that is now rising and is projected to exceed 115 million by 2050. [7] Came up with the first commercially available Smartphone named Simon was developed and made available by IBM in 1994. Since then, Smartphone has been evolving rapidly. Apart from phone call and SMS, Smartphone sex hi bits some functionality of

laptops and desktop computers. Thus, replacing these devices in real-world computing applications. [8] Worked on the ability of Smart phones to integrate several major functionalities such as communication, multimedia, and games, portraying it as a strong tool that enhances business opportunities, personnel's productivity, and employment opportunities. An interesting advantage of a Smartphone was its flexibility and mobility which enable sit to incorporate hundreds of heterogeneous network access. The availability of wireless network had played a huge role in the development of new spectrum applications that provides huge information access, anytime, from several devices. [9] Come up with an improved number of visually disabled and blind people. While they had many applications and different features, most of them were for the sighted and were not available to blind people. The main problem faced by them was identification of things used in their daily life or to read a text or a book. Therefore, this application provided various functions such as light detection, color detection, object budget recognition, and bank note recognition. Since the application targets visually impaired persons, the performance results were read out loud. It uses the cell phone's built-in voice engine to read out the results loudly so that the user can hear them. Segregated or regular schools were the two main forms of education system available for visually impaired and blind students in many countries. Research by [10] showed that there are three main factors impacting the placement of visually impaired or blind children into certain types of educational institutions. First, sending a blind child to a segregated school tends to be a choice out of no choice. The traditional view w a s that physically impaired children can only be educated in a special school. In our societies, medical treatment and segregated education were often regarded as the only solution for blind children. Second, when it comes to choosing schools, it might be the parent's choices of the teachers instead of the choices of the schools [10].Regular school teachers were found to have negative attitudes towards blind students. Therefore, teachers' negative attitudes, lack of provision, and shortage of supporting materials in regular schools were reasons that parents prefer sending blind children to special education schools instead of regular schools. The last, in some cases, blind children are studying in regular schools on the first hand, but they went back to studying in special education schools within a few years. They failed to study with sighted peers due to the lack of provision and support in regular schools [11]. As mentioned by [12] difficulties that a disabled person encounters tend to come from three different levels: physical and medical limitations, environmental limitations, and the need for extra support. To enable them to be aware of the space and where they are located, orientation training should be provided. To develop their abilities to go wherever they wish to go safely and independently, mobility training should be provided. This study [13] aims to acknowledge the information needed by visually-impaired students in Indonesia. The results of this study were based to develop library services that can be useful for visually-impaired students. The research was conducted in YPAB in Surabaya and involved 30 visually-impaired students ranging from 11-20 years of age. There search was conducted using questionnaires and interviews at YPAB. From the results it can be known that all students regularly visit the library 1-4 times a week, they know about the library services in the school from the teachers and the most widely used service was the general collection service in braille format [13]. The most frequent activities done by students were chatting and discussing, whereas browsing was rarely because there was no internet connection and the number of computers islimited. The information available in the library includes information for completing school work and fiction books in the form of braille. The recommendations from research results include: improving information services through teacher librarians and providing information and internet literacy training for students and teachers

This study, [14] presents the recent advances in Deep Learning and Computer Vision that had led to excellent Image Captioning models using advanced techniques like Deep Reinforcement Learning. These captions can then be read out loud to the visually impaired so that they can have a better understanding of their surroundings. Our model uses a CNN to extract features from an image which was then converted into a sentence, describing the image's invalid English by feeding it to a recurrent neural network or a Long Short-Term Memory network. We believe that our model with greatly improve the life of visually impaired people by allowing them to understand their surroundings. This research [15] aimed to explore the actual situation of information accessibility for university students with visual impairment at higher academic institutions in Lahore, Pakistan. This research adopted a qualitative research design using IPA to investigate the phenomenon. The participants were recruited with purposive sampling from higher academic institutions for data collection. Face-to-face interview with 15 visually impaired students was conducted using an interview guide. The participants were debriefed for data authentication and verification at the end. Each interview was transcribed and analyzed carefully using IPA. [15] The results indicated that these students utilized interpersonal relationships as the primary source of their academic information. The other available facilities for information access included the internet, disability resources center (if available at the institution), and the university library. The major barriers to accessing needed information included: format barriers, navigational barriers, technical barriers, ICTs illiteracy, and financial barriers. The university administration, especially libraries,

should consider students with various disabilities while designing information infrastructure for its community. The research can be used as a guide by the library staff in designing need-based information services for students with visual imprisonment. This research would be a worthy con tribution to the existing literature as only a few studies were conducted in Pakistan. Paper [16] introduced a system that reads text on a captured Image. It was performed as text extracted from the scanned image using Tesser act OCR and then converted the text to speech by the e-Speak tool. The first captured image was converted to grayscale and then filtered using a Gaussian filter to reduce noise adaptive Gaussian thres holding. It was converted to a binary image and cropped and loaded to Tesseract OCR for text recognition and the output of Tesseract was a text file that was input fore-speak, which produces audio. The paper [17] adopted a prototype that helped people to hear the text content of the image in their native language. The text was extracted from the image and then the text was converted to translate the speech of the user's native language. The camera captures the image and then the OCR engine converts the image to text. Then the text was converted into speech using the e-Speak TTS engine. The speech output was then stored in a FLAC file. This file was then converted into the desired language by the Microsoft Translator using a Python script.

2.1. Review

Table 1 portrays the methodology, advantages, and disadvantages of the existing method. We considered papers that used a different methodology that helped visually impaired people. Each method has certain benefits and short comings, that were detailed explained in.

Author	Methodology	Advantages	Disadvantages
Shubham Suman, *et al.* **[2]**	Google cloud vision API	• Improved the usability and reach ability of technology. • Helped individuals to perform basic services like making calls, sending and reading messages, and saving reminders or notes on an Android device. • Reliable and efficient in helping visually impaired individuals perform tasks on an Android device.	• The application had limitations in terms of its functionality and compatibility with different Android devices. • It required regular updates and maintenance to ensure its reliability and efficiency.
Bharadwaj, *et al.* **[6]**	RFID reader and PHP	• Reduced the need for scribes that were costly and time-consuming to arrange. • User-friendly and accessible.	• The system relied on technology limitations • Required initial setup and training for both students and teachers • Time-consuming
M.Awadand J. Haddad, *et al.* **[9]**	JAVA, PHP and MySQL	• Reduced the costs and complexity, and increases the practicality of the application. • User-friendly interface.	• The detection may not be as accurate as dedicated hardware. • Required technical proficiency to set up and use.
Ahmed, *et al.* **[15]**	Qualitative research design	• Focused on individual perspectives and unique contexts. • Identified the primary sources of academic information. • Developed more accessible information infrastructure and services for this population.	• Results may not be generalizable to other populations or contexts. • IPA required a significant amount of time and effort to analyze the data carefully.
MR. Rajesh, *et al.* **[16]**	OCR methods	• Performs effectively with high accuracy. • Improved image quality. • Fix errors and improves the effectiveness of the result. • Performed automatic video indexing.	• Required a certain level of expertise to implement and use effectively.
Rithika. H *et al.* **[17]**	Raspberry Pi	• Accessible for a wide range of users. • Easy to use. • Cost-effective and open source.	• Accuracy depends on various factors.

2.2. Challenges

From the literature, it can be deduced that students with visual impairment are facing various challenges in their academics. Furthermore, little research exists on addressing the needs of these

disabled students. Although some applications are available to help them interact with digital devices, and tons of Android applications are aimed at solving the challenges students are facing, there are fewer applications available for reading question papers for visually impaired students. This research will narrow its focus on providing an android-based solution for reading out question papers to the visually impaired students which will reduce their dependency on other students during exams.

3. Methodology

The success of any software development depends largely on how accurately the problem is defined and understood, and the thorough investigation that is properly carried out in the choice of solution process. Software development project becomes better understood as it progresses through analysis and design. However, system development should not commence until enough information is available to permit the preliminary planning and to ensure that the system is feasible.

The choice of the SDLC model to be adopted in a software development process is a decision that should be made with an eye toward the nature of the software and the time allotted for the development. As such, this project chose the iterative model as the SDLC model to be used.

In the Iterative Model, the software is first developed on a very small scale and all the steps are followed which are taken into consideration. Then on every next iteration, more features and modules are designed, coded, tested, and added to the software. Every cycle produces software, which is complete in itself and has more features and capabilities than that of the previous one.

Unlike the more traditional waterfall model, which focuses on a stringent step-by-step process of development stages, the iterative model is best thought of as a cyclical process. After an initial planning phase, a small handful of stages are repeated over and over, with each completion of the cycle incrementally improving and iterating on the software. Enhancements can quickly be recognized and implemented throughout each iteration, allowing the next iteration to be atleast marginally better than the last. The various   stages in the iterative model include:

- Planning and Requirements
- Analysis and Design
- Implementation
- Testing
- Evaluation

Figure 1 represents the overall phases of the iterative model.
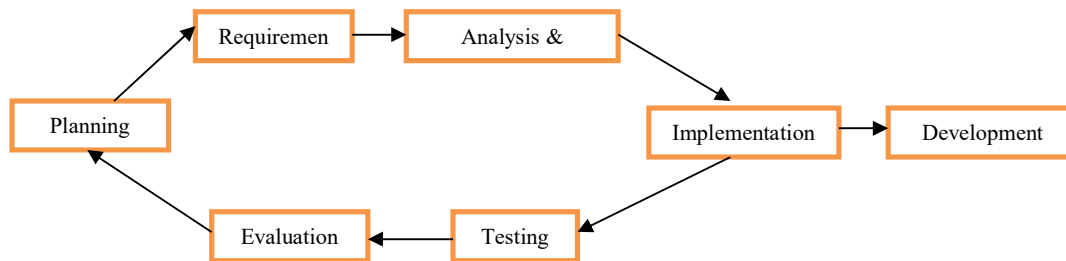
Fig.1. *Phases of Iterative Model*

4. Overview of the System

This project narrows its focus on developing an android application that read out question papers to the visually impaired student. The application gives a lecturer /exam officer the privilege to upload a pdf version of a question paper and set the date, time, and invigilation key to a particular course. A lecturer can modify the already exam time, date, and invigilation key. He/ She can also delete already uploaded questions.

From the student`s perspective, a student can listen to a speech version of the questions with an easy way of navigating through the questions by simply pressing the upper or lower volume button. The uploaded question scan only be accessed by a student when the date and time of the exams are due, and after the invigilation key has been inputted by an invigilator.

4.1. Functional Requirement

A functional requirement describes what software has t o do. It is also called product features. The

functional requirements for this system are as follows:
- The system should provide a means of uploading questions.
- Its system should provide a means of managing the already uploaded questions.
- It should be able to read out questions to the user.
- It should provide a venue where a user can sign up before he starts using the application.
- It should be able to authenticate a user before providing access to the application.

4.2. Non-Functional Requirements

Non-functional requirements stipulate how well a system should do what it has to do. The non-functional requirements of this system are listed below:
- The system should be very user-friendly as it will be used by visually impaired students.
- It Should provide an easy way of navigating from one question to another.
- It should ensure that the time and date of an examination are due before providing access to the question to avoid leakage of questions.

4.3. Programming Language

The programming language used for this project is Java. It is an independent object-oriented language that is used for developing software including but not limited to Android applications. Java is a program that does not compile to native processor code but rather it refers to a virtual machine that understands an intermediate format (java byte-code). Each platform that uses Java to run needs a virtual device. An Android application is built on a custom virtual machine known as DVM.

4.4. System Design

System design involved defining the architecture, modules, interfaces, and data for a system to satisfy specified requirements. The identified requirements were converted to the architectures and models of the proposed system.

5. Flow Chart

The flowchart is a diagram that represents a work flow or process, it provides a diagrammatic representation of an algorithm. Figure 2 represents the flow of the application. Initially, the application will verify whether it is admin or not. If the user and password are authenticated properly then the display menu appears and grants access to all admin privileges. If the username and password are incorrect, the input invigilation key is sent for authentication. If the key is valid then the questions were displayed to read.
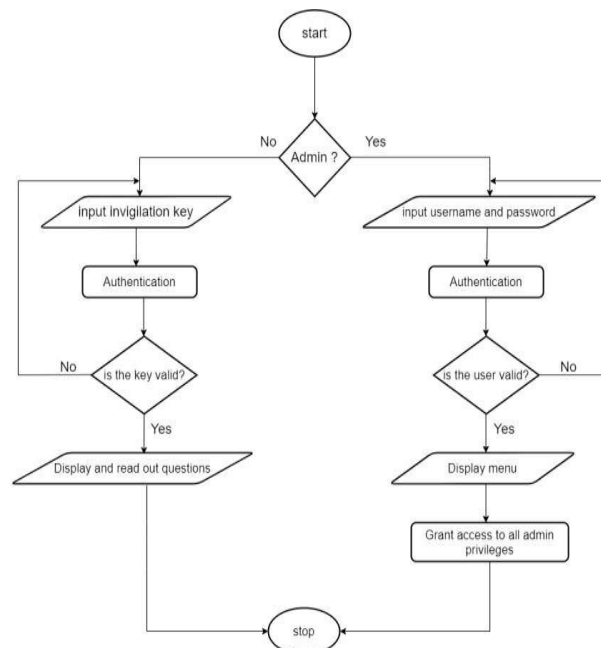

Fig . 2. *Flow Chart of the Application.*

6. Use Case Diagram

A use case diagram is a representation of a user's interaction with the system and depicts the specifications of a use case. A use case diagram can portray the different types of users of a system and the various ways that they interact with the system. Fig. 3 illustrated the use case diagram of this paper.

The admin can access signup, login, create exam schedule, exit exam schedule, delete exam schedule, change password, retrieve password, view exam schedule, and logout. The invigilator can access unlock exam and logout. The student can listen to the questions.
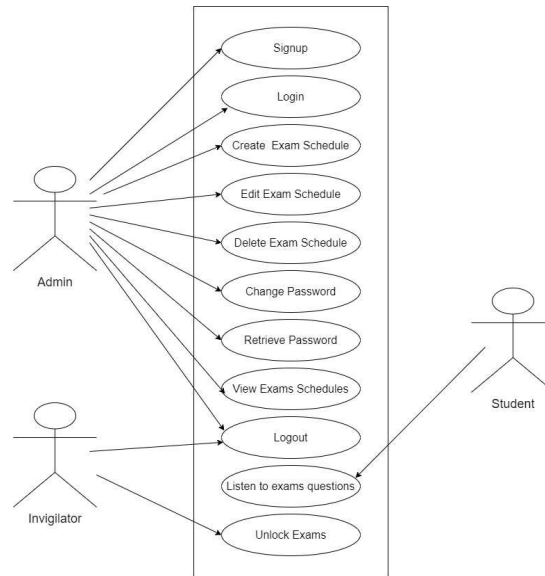
Fig. 3. *Use Case Diagram of the Application*

7. Entity Relationship Diagram (ERD)

ER diagram is a specialized graphic that illustrates the relationships between entities in a database or system. It illustrates the logical structure of databases. Where the admin manages the question paper. In the admin panel, it contains username, password, and email. In the question paper, it contains course code, date, time, question, and invigilator key. Figure 4 represents the entity relationship diagram of the application database.
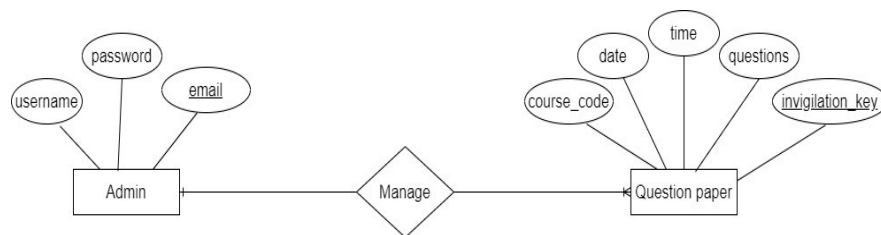
Fig. 4. *Entity relationship diagram of the application's database*

7.1. Database Design

Database design is the process of producing a well-structured data model of a database. Database design can be thought of as the logical design of the base data structures used to store the data. An ER diagram was used to depict the logical view of the database.

7.2. Database Tables

In the database table, the admin database contains fields, types, null, extra, and pay. The field contains username, password, and email. The types of the field are text and varchar. For the exam schedule table, the fields are c_code, Invigilation_key, Date, Time, and Questions. The field types are text, date, and time. Fig. 2 represents the admin table and Figure 3 represents the exam schedule table.

Table2. Admin Table

Fields	Types	Null	Extra	Key
Username	Text	Not null		No
Password	Varchar	Not null		No
Email	Varchar	Not null	PK	Yes

Table3. Exams Schedules Table

Fields	Types	Null	Extra	Key
c_code	Text	Not null		No
Invigilation_key	Text	Not null	PK	Yes
Date	Date	Not null		No
Time	Time	Not null		No
Questions	Text	Not null		No

8. System Implementation and Testing

Implementation of a system involves putting all the theoretical design into the practical design to put the new system into operation. System implementation is a process that converts the system requirements and design into program code. To implement a system successfully, several interrelated tasks need to be carried out in an appropriate sequence. System implementation refers to the transformation of the logical system design into program codes.

8.1 System Requirement

Determining the resources needed to successfully develop software is a paramount task in system implementation. The various necessities (resources) needed for the proper functionality of the proposed systems are: software components resources, and hardware requirements.

8.2 Software Requirement

Software is a set of instructions that enables a computer to perform a particular task. The software required for the smooth running of the proposed system is Android OS Version4.0 or above.

8.3 Hardware Requirement

Hardware is the physical component of a computer, it provides a platform that supports software on a computer. For this study, the under-listed hardware is required for the smooth running of the proposed Android application. They are as follows:

- The mobile device is supported by the Android operating system.
- Android mobile device with an internal memory of 15MB or above.
- Head phones or Earphones for listening to the questions during examination.

9. Advantages and Disadvantages

Advantages

- The application provides visually impaired students with the ability to read examination questions independently, without the need for special consideration or attention from examiners.
- The application is designed to work on mobile devices supported by the Android operating system, which is a widely used platform.
- The iterative model used in the development of the application allows for incremental improvements and enhancements to be made throughout the development process.
- The application is capable of reading out questions written in the English language, which is a common language used in many educational institutions.
- The application can help to reduce the difficulties faced by visually impaired students during their exams, which can improve their overall academic performance.

Disadvantages

- It can read questions written in the English language only, and it cannot read tables or describe figures.
- It cannot be accessed in other operating systems.

10. Result and Discussion

This section explains show the flow of interactive android-based examination questions reader application for visually impaired students works, how to evaluate the system in terms of interface and its storage, and the results of the evaluation of the user from Fig.5 to Fig.14 below.
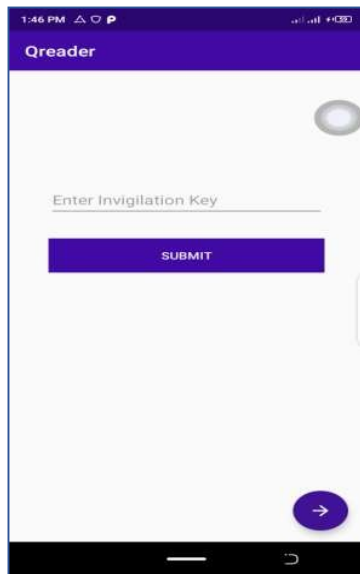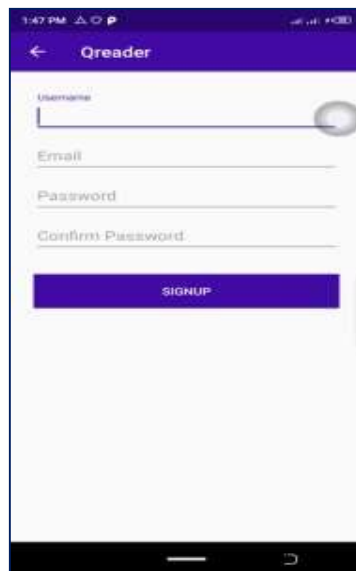

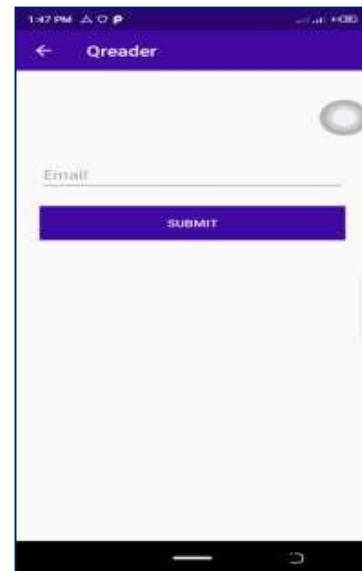***Fig. 5.*** *Examination authentication activity*
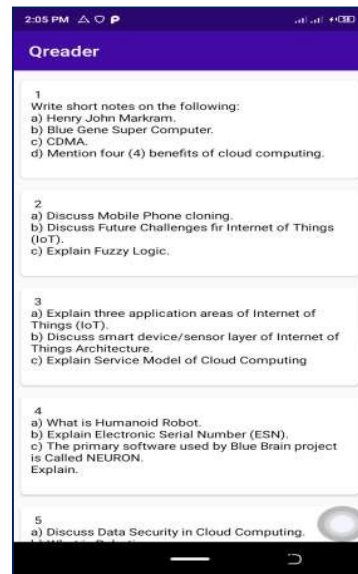
Fig. 6. *Question reader activity*

Fig. 7. *Admin login act*

Fig. 8. *Sign-up activity*

Fig. 9. *Forgot password activity*
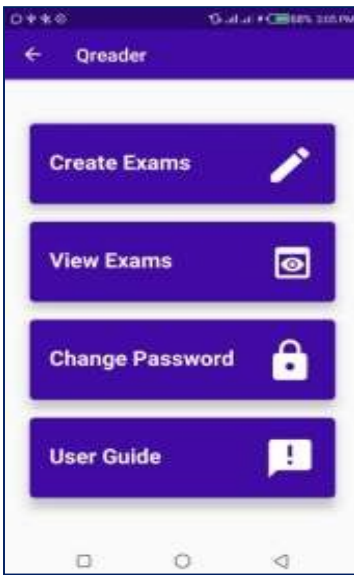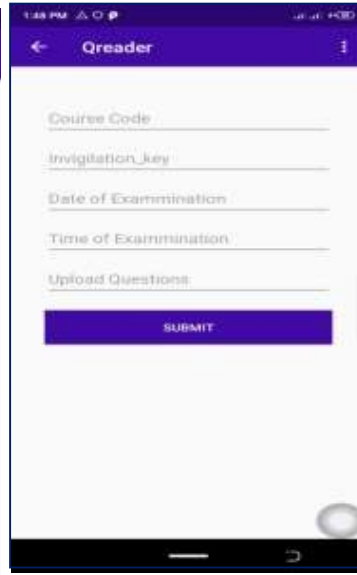
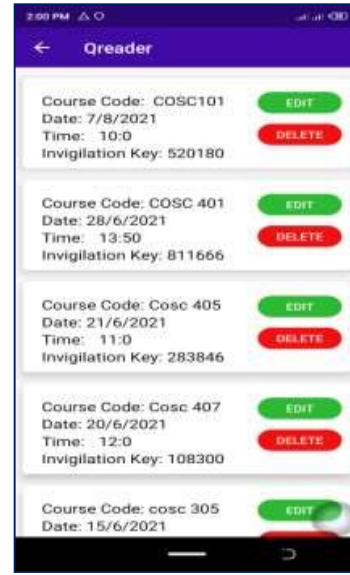**Fig. 10.** *Menu act*   **Fig. 11.** *Create exams act*   **Fig. 12.***View exams schedule activity*
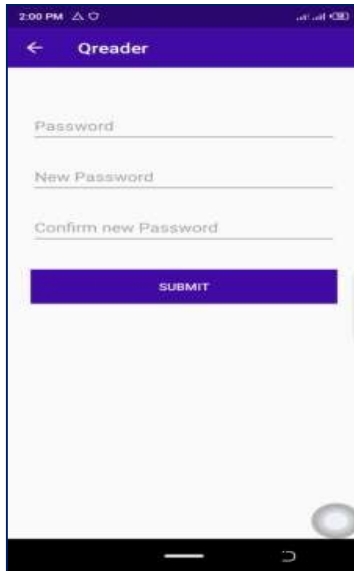

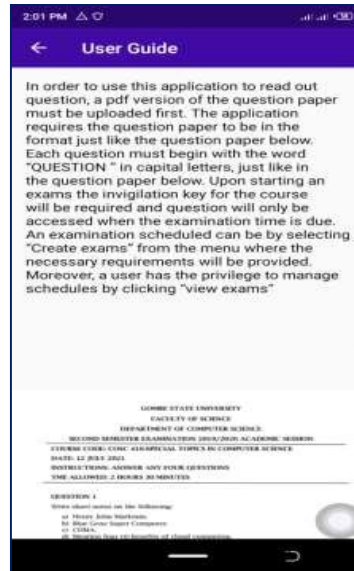**Fig. 13**. *Change password activity*   **Fig. 14.** *User guide activity*

Fig. 5 Portraits the examination authentication activity, it contains only one input field which collects the invigilation key and authenticates it before providing access to the questions activity. The invigilation key of the course whose examination is to be written is expected to be entered by the invigilator. Similarly, when the admin button is clicked the admin login activity will be displayed.

Fig. 6 shows the question reader activity where the questions are read out to the hearing of the student. This activity is of utmost importance to this application as it contains the implementation of one of the functional requirements of this application which is "It should be able to read out questions to the user." After the evaluation of the system, the users confirm that the system is reading accordingly with fewer errors and can be corrected easily.

Fig. 7 is the admin login activity; it contains two input fields that collect the username and password of the admin before granting access to the menu activity. The admin login activity is very important to the application because it helps in accomplishing one of the functional requirements of the E system which is "It should be able to authenticate a user before providing access to the application." It also contains forgot password and a sign-up link which takes the user to forgot password and sign-up activity respectively when clicked. The admin login activity is very important because it will prevent unauthorized access to the application. However, even if a person forgot his password, he can retrieve the password by clicking "Forgot password" which will take him to forgot password activity demonstrated in

Figure 10 where he will enter his email and the password will be retrieved. An admin can only login if he has created an account. Otherwise, he will have to sign up first.

Fig. 8 shows the sign-up activity, it contains four fields for collecting the username, email, and password and confirms the password. Whenever a new admin is to be created, these details must be submitted first through this form. Upon successful submission, the user will be redirected to login activity so that he can login and start using the application.

Fig. 9 shows the forgot password activity. When an admin forgot his password, he will be required to enter his email and his password will be displayed on a card.

Fig. 10 demonstrates the menu activity, which contains four menu items each of which leads users to several functionalities. A click on each of those options would invoke an Android intent that would open the next Android activity. These menu items from top to bottom are: Create exams, view exams, change password, and user guide.

Fig. 11 portrays the Create Exams activity. The interface contains five input fields required to be filled and submitted to upload a question successfully. When the question is uploaded, the menu activity will be launched programmatically.

Fig.12 shows the view exams schedules activity shows the list of examination schedules that have been uploaded earlier. Each card holds details of an examination schedule; course code, date, time, and invigilation key. Upon clicking delete the current schedule gets deleted. So also, the if edit button is clicked an activity gets launched that provides the interface to edit the schedule

Fig. 13 portrays the change password activity. It contains three input fields for the old password new password and confirm password. Upon successful submission of these details, the password gets changed and the menu activity gets launched programmatically.

Fig. 14 Portraits the user guide activity. It provides a guide on how to use the application and a template of the question paper that the application will work with.

11. Testing

11.1 System Testing

Testing is an activity that is conducted to ensure that a system conforms to the given requirements. System testing means executing the software with some data to ensure that the software works correctly as required. Testing has been conducted during and after the development of this application. For this project, the following testing techniques were used.

11.2 Unit Testing

During the unit testing of the application conducted during coding, different modules of the application (activity classes) were debugged using log cat which gives information to the developer on errors and suggestions.

11.3 Integrated Testing

At this stage, it is expected that a system has passed through unit testing. Subsequently, the focus will be narrowed to the flow of control and data exchange among various activities of the application. To test these functionalities, an Android emulator and a Smartphone were used to see how different activity interacts with each other. After the test, many semantic errors were detected and corrected.

11.4 Beta Testing

Beta testing is a form of testing that is usually carried out when software is fully functional. In this form of testing, a version of the software known as the beta version is distributed to users to test it and give feedback on their experience with the software. In the course of developing this software, beta testing was conducted by distributing this software to various students for evaluation. Many feedbacks were received from the student about their experience on the application. Later on, these feedbacks were analyzed and changes were made to the software. Some of the feedback received from the testers is as follows:

- The question should only be accessed when the exam time is due.
- When the password is retrieved it should be displayed on a dialog rather than in a toast.
- The speed of the voice when reading questions should be reduced so that it will be comprehended properly.

All these feedbacks were considered and changes were made as per observations so that the

application will be usable and easy to interact with users as it will deal with not only visually sound users but including visually impaired students.

12. Summary

This project has identified a problem that visually impaired students used to encounter during examinations as they use to depend on someone to readout questions for them. This project has solved this problem by developing an Android application that can read out questions to the student. Several literatures related to this project have been reviewed and similar software that possesses similar capabilities has been examined. Moreover, the requirement has been gathered through interview and brainstorming. To make the development process systematic, an iterative model was adopted as the SDLC approach for the development. Various diagrams were used to depict various aspects of the system. Consequently, the software was coded successfully in Java programming language and XML (Extensible markup language), and it was tested successfully to ensure that it met the user requirement.

13. Conclusion

This project set out to address the difficulty visually impaired students encountered when perceiving questions in an examination and a fully functional android application for reading out questions to the students was developed successfully after reviewing similar works to identify areas for improvement and obtaining vital requirements. Hence it can be concluded that the aim of this project has been achieved.

14. Recommendation for Future Work

The Android application will be enhanced with the support of many languages and support other operating system.   Furthermore, a detailed analysis has to be done to understand the effectiveness of the proposed method in improving the academic performance of visually impaired students.

Compliance with Ethical Standards

Conflicts of interest: Authors declared that they have no conflict of interest.

Human participants: The conducted research follows the ethical standards and the authors ensured that they have not conducted any studies with human participants or animals.

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