Story Catcher: e-library to Improve Early Literacy Skills and Verbal Fluency in Kids

MTA Deen[1#], DSS Jithmisha[2], PDCJ Paranagama[1], HHAMI Hettiarachchi[1] and WPJ Pemarathne[1]

[1]Department of Computer Science, General Sir John Kotelawala Defence University, Sri Lank
[2]Department of Computer Engineering, General Sir John Kotelawala Defence University, Sri Lanka

[#] 37-cs-0007@kdu.ac.lk

Abstract: Mobile smart devices are gaining popularity rapidly. These digital devices facilitate a new generation of technological tools that offer unprecedented access to content as well as opportunities for creative use even for young children. The development of mobile technology and the proliferation of smartphones have made m-Learning and e-Learning one of the most efficient methods of learning. Previous studies have explained the positive impact of using e-library mobile applications to develop literacy skills of children. Despite positive outcomes, Sri Lanka does not have an e-library mobile application for children to improve their reading and writing skills in both Sinhala and English. A solution to overcome this problem is to develop an e- library mobile application for kids. Story Catcher e-library mobile application contains books, poems, and songs in both Sinhala and English languages with the special narrating feature which helps kids to learn correct pronunciation and to improve verbal fluency, and communication skills. Special features like a screen time management option for parental control and to avoid overuse, an interactive game for the kids and an option to add or remove any book, song and poem from favourites are included in this mobile application. This research paper proposes a novel method to improve the literacy skills of kids in Sri Lanka.

Keywords: Kids e-library, Android Development, literacy Skills, , Child-Computer Interaction.

1. Introduction

Mobile devices and technology have been rapidly developing in the past few years. As a result of this growth in technology mobile phones are a very common sight in today's society and have made life much easier. The technology advancement has affected the children as well. Children too at a very small age start to use mobile phones, tablets, and other digital devices. These devices have become a part of the children's life and if used properly, it can help them in their development process specially in education. m-Learning and e-Learning has become one of the most efficient methods of learning with the advancement in mobile technology and expansion of smartphone use. People can have access to various content and productivity tools by just a few clicks. This has made learning, reading, and writing easy and simple.

There are various e-Library mobile applications that are freely available to download to our smartphone. These e-Library mobile applications are in various languages and grouped into kids, teenagers, adults, and various other categorizations.

According to the literature review conducted, there is no existing e-Library mobile application for kids with both Sinhala and English material. This paper covers, a mobile application named "Story Catcher" consisting of books, poems, and songs in both English and Sinhala languages. The intended users are kids below the age of 8.

Reading is very important for a growing child to develop early literacy skills. This mobile application provides the opportunity to develop the reading and listening skill. With the text and narrative feature, a child's pronunciation, verbal fluency, and communication skills can be developed. The inclusion of poems and songs in the application is another way of helping the child's language and literacy development. Singing songs and reciting poems are great activities to boost a child's imagination and stimulate curiosity. Having bilingual material will allow the child to experience a cultural background and learn two languages.

The mentioned mobile application will help kids with special needs as well. The narrative feature helps to reduce frustration if the child does not know how to pronounce a particular word. Kids increase their sight word recognition once the correct pronunciation is heard (Schanck and Waller, 2013).

Due to the busy lifestyle that exists today, parents are unable to direct their children to read books. At this playful age, children are less interested in reading and show more interest in using digital devices to watch animated cartoons. So, we can see this as an opportunity to use technology to guide children to read.

Today, children are in touch with new technology. One of the common problems is that they spend excessive amount of time using these devices because of not having the screen time feature in most of the mobile applications.
As a solution for the mentioned problems the proposed, safe digital media platform named 'Story Catcher' e-library for kids is a unique solution.

2. Literature Review

E-Library mobile applications are the latest reading platform that provides an online database with a huge collection of books, poems, articles, magazines, etc. While e-Books have been around for many years, recent improvements in the adaptability and affordability of smartphones, tablets, and other digital devices along with increased access to the internet have led to a dramatic increase in the use of e-Books. According to research by Irene Picton on "The Impact of eBooks on Reading Motivation and Reading Skills of Children and Young People", 53% of children use digital devices to read books (Picton, 2014).

"Story Catcher e-Library" is designed for kids below age of 8. Due to the age factor, the design of the interface and user-friendliness of the application are necessary aspects to consider. The research paper "Developing Mobile Applications or Children" it states that Rose Kivi writes "the colours red, orange and yellow simulate and increase brain activity and the colours green, blue and violet induce relaxation". Rose Kivi also states that a comfortable feeling can be induced using warm colours, while bright colours create a feeling of excitement (Wängberg, 2012).

Here are some of the existing kids e-Library applications:
"Epic" is one of the leading digital reading platforms for kids 12 and under. This application offers access to more than 40,000 English books, learning videos, and reading quizzes for kids. With "Epic", the parent can track the child's reading progress as well as the time spent reading. 'Epic' for home and 'Epic' for educators are the two versions available through the app. The downside of it is that this application does not provide an interactive learning experience for kids (quizzes, games). "Epic" users can try the free version prior to purchasing the full application. "Epic" is available for both Apple iOS and Android platform (Epic,2021).

"Little Stories" is another mobile application for kids 8 and under. This application consists of 1000+ pictures, 21 exciting bedtime English fairy tales for toddlers. By using this application, parent or the kid can create audiobooks by recording their own voice but does not provide the user with pre-recorded audiobooks. "Little Stories" mobile application users can try the application for free prior to purchasing the full app. This application is available for both Apple iOS and Android platform (Little Stories Bedtime books,2021).

"Smart Kidz Club" for kids and toddlers is an exclusive library of English audiobooks, read to me e-Books, flashcards, learning games for kids 2-11 years old. The application motivates kids with awarding badges, encourages kids with rewards and challenges kids with a leaderboard. "Smart Kidz Club" application is available for both Android and iOS users (SmartKidzClub,2021).

"Lama Katha" is a kids e-Library mobile application which only includes books in the Sinhala language. This application consists of Children's stories and Jana Katha. There are no audiobooks included in this application. "Lama Katha" is only available for mobile devices that run on the Android platform (LamaKatha,2021).

"Let's read" mobile application consists of books that are 100% free to read. Favourite books are free to download and save for reading at any time, online, or offline. Multilingual readers can switch between languages within the storybooks with a quick tap, accessing the many languages available on the Let's Read app, including English. "Let's read" is only available for mobile devices that run on the Android platform (LetsRead,2021).

"Vooks" application transport stories off the page, promoting literacy, imagination, and fun for children 2 - 8 years old. This mobile application is a kid safe, ad-free streaming library of read aloud animated English storybooks. "Vooks" users can try the free version prior to purchasing the full application. "Vooks" is available for both Apple iOS and Android platform (Vooks,2021).

The purpose of this review was to view the features and trends in kids' e-library mobile applications which have a higher rating in Google Play Store and Apple App Store and are developed within the past few years. It is clear from the research reviewed that the kids' physical and mental well-being takes place a major role when developing kids' mobile applications. When comparing the existing kids' e- library mobile applications and the story catcher mobile application, Story Catcher has been developed with the newest features which were not found in existing mobile applications. Features like screen time and kids safe setting button were not found in any of the existing kids' e-library applications. Story Catcher is the only mobile application that offers books, poems, and songs in both Sinhala and English. A comparison of the game section shows that Story Catcher provides an interactive learning experience for kids through games, whereas Little Stories, Lama Katha, Lets Read, and Vooks do not.

3. Design and Implementation

The system design is an integral part of any successful system. A system's design involves defining its elements such as modules, architecture, components, interfaces, and data based on its specifications.

A. Architectural Design

The architecture design describes the components and specifications required to support the solution and ensure that the design meets the specific business and technical requirements. Simply we can say that architectural design defines the overall structure of the system. The architectural design is given according to the three-tier-architecture. The three-tier architecture splits the overall design in to three layers as presentation tier which is the user interface, application tier where the data is processed and lastly data tier where the data associated with the application is stored and managed.
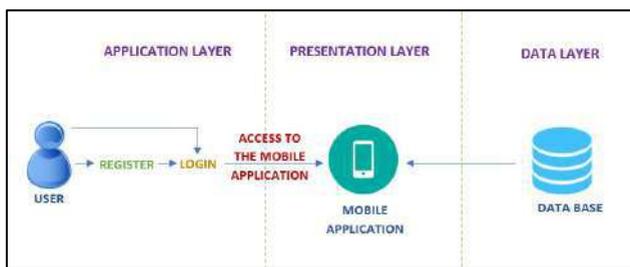

Figure 1.   System Architecture

1) Application Tier: This is the heart of the mobile application. In this tier, data collected from the presentation tier is analysed and then can add, delete, or modify data in the data tier. In our system, application tier is developed using Java and communication with the data tier is done using API calls. The application layer connects to the presentation tier and the data tier. Typically, administrator has the ability to control application tier. The information about the kid, parent and the tasks of both parties will be displayed in the application tier. Application layer interacts with both layers therefore changes done in this section affects both presentation and data tiers.

2) Data Tier: The data tier, also known as the database or data access tier, is where the application stores and manages the information processed. This is the section where all the database management applications run. In the "Story Catcher" mobile application, the database used is Firebase database which is a cloud hosted NoSQL database that stores and sync data between users in real time. The user details, books, songs, poems, and games are stored in the Firebase database.

3) Presentation Tier: The presentation tier is the user interface and communication layer of the application, where the end user interacts with the application. In general, it displays information to users and collects information from them. Presentation tier is the only layer that user can see and interacts with. The presentation layer is designed considering the kids' point of view with an attractive user interface and kids friendly user experience. User registration, and the current situation of the requests are happening in this layer. User has the ability to enter details in the presentation layer and the details entered in the presentation layer get delivered to the application layer.

B. Modular Architecture

Using modular architecture when designing the mobile application allows to redo parts without affecting the rest, and it facilitates maintenance by being divided into smaller and lesser complex parts. Each module has a unique responsibility and unique functional behaviour. Below categorized modules can change without affecting each other and can communicate with other modules without knowing them completely.

Module 1: "Login and Register Module"
1.1 User registration
1.2 User login
1.3 Reset password

Module 2: "Library Module"
2.1 Select and read any book, poem, and song in Sinhala or English language.
2.2 Add favourite books, songs, and poems to My library.
2.3 Select text only or read with narration option.
2.4 Search books, poems, and songs
Module 3: "Game Module"
3.1 Play games

Module 4: "Settings Module"
4.1 Setting the screen time
4.2 Change user information
4.3 User logout

C. Data Design

The data design helps to manage the data storage and database operations of the system. To store data and information of the mobile applications, Firebase is used as the database. The user details, books, poems, and songs are stored in the Firebase database. Firebase allows to store and sync data in real-time.

D. Interface Design

The graphical user interface of the Story Catcher mobile application is where all functionalities are grouped visually and logically into thematic unit. The user interface is a crucial aspect of the system in terms of what the client wants and needs. Keep the interface simple, create consistency and use common user interface elements and strategically use colour and texture are some of the best practices for designing an interface.

A Splash Screen appears when the application is launched, the splash screen consists of the application logo. For kids and parents to get an immediate positive impression about the application, the logo of the application is designed.

When designing the mobile application, the important factors to consider are easy navigation and fast fill out, as

Figure 2. Application Interfaces

users could get frustrated by the complexity of the application. Minimalistic approach when designing the buttons and other elements so that the application looks clean, and user can easily access the application. The typeface is not in cursive or italics since those are difficult to read. Using different shapes in different screens like circles, ovels, squares etc. to invoke user's creative mind. As small children do not know how to read so they rely on symbols mostly. The icons used are very simple and easily understandable.

Colours play a special role in evoking powerful emotions in humans. For the interfaces, colours that induce feelings and emotions to the user are used. The colours are used such that the background and icons become more contrasted. Additionally, the colours are gender neutral colours that induces relaxation and helps to focus creating a learning environment for the kids. The background images in certain screen have reduced opacity so that it will not disturb the main content.

The settings are meant for the parent, so it is placed away from the main section of the screen, making it less likely to be pressed by accident. The Settings icon does not stand out as much from the surrounding. When it is double tapped, the first tap will change the colour and make it clearly visible, and the second tap will change interface to the Settings layout.

E. System Requirements

Story Catcher is an Android mobile application, so it is necessary to have a mobile with Android OS. The minimum specification to run the application smoothly is as follows:

- RAM 3GB
- Android version- 4.2 Jelly Bean
- Chipset- Snapdragon 410
- CPU- Quadcore 1.2 GHz
- 5'' touch screen display
- 500 mb free memory space
- Internet connection

4. Technology Adopted

New technological approaches emerge every day. Appropriate development environment is necessary to develop a successful mobile application. When selecting these technologies, it is necessary explore and study the features, benefits, and limitations of the available technologies and select which is most appropriate for the fulfilment of tasks relevant to the project's nature and requirements. The following technologies and platforms were used to accomplish this: Android Studio, Figma, Adobe Photoshop, and Firebase.

Figma is a collaborative interface tool which is used to design user interfaces of an application or system. Designing the user interfaces and getting an idea of the layout was done using Figma. The Figma Mirror feature allows to view the design in our mobile and get a hands-on experience on how the designed user interface will look in a mobile.

Android Studio is the official integrated development environment for Google's Android operating system

designed specifically for Android development. As Android Studio is also considered as stable IDE and development is faster in Android Studio as it is specifically designed to accelerate the process of Android mobile application development. A highly integrated Gradle build system is used in Android Studio, this tool offers dependency management which helps to enhance the developer experience because its more extensible

Firebase database was used as the database for the mobile application. Firebase database is a cloud hosted NoSQL database that let the user store and sync data in real-time. The Firebase Cloud Firestore database type is used in this application since Cloud Firestore is more permissive in term of queries.

Adobe photoshop is a photo editing and manipulating software which is used for design purposes. In the process of designing the "Story Catcher" mobile application Adobe Photoshop was used to edit images, design wordings and match colours. In designing minor elements of the interface, Adobe Photoshop's vast array of tools and options are of great help.

5. Results and Discussion

The "Story Catcher" e-library mobile application is an age-appropriate mobile application specially designed for kids. According to the research and survey carried out, the shortcomings in existing kids e-library mobile applications were identified and the issues faced by parents by letting the kids use these applications. The unavailability of fruitful content for kids in these existing mobile applications is a problem. With today's busy schedule, parents have less time to read to their kids and using e-library mobile applications from the e-library is a good solution for this. However, allowing kids to use digital devices raises the concerns of addiction and overuse.

According to these problems identified, and as a solution the "Story Catcher" e library mobile application is developed to reduce these problems. A screen time feature is included in the mobile application. The main reason for adding this option is to avoid the kid from overusing the application and avoid addiction for the smart digital devices. The screen time feature allows parents to set a time for their children to use the application and when the timer runs out, the application closes automatically. We have added screen time up to 40 minutes with the option of selecting 6-time limits (15 minutes, 20 minutes, 25 minutes, 30 minutes, 35 minutes, and 40 minutes).

The "Story Catcher" e-library mobile application consists of books, songs and poems in both Sinhala and English languages. Providing the opportunity for kids to spend a fun and educative time in a learning environment. The inclusion of bilingual material will give the child to experience cultural background and learn two languages.

In the "Story Catcher" mobile application, the opportunity to choose between the read only option and read with narration option is available. The read with narration helps the child in pronunciation, listening skill, imagination, verbal fluency, and communication skills. The read only option will also help the kid in sight word recognition, boost the kid's imagination, improves brain connectivity, verbal fluency and helps in early literacy skills.

The "My Library" feature is another important feature in the application. This feature enables the kids to add their favourites to their "My Library". By directly going to the "My Library" screen the kid can access their favourites without having to use the search option or going through the full library in search of one specific item. Removal of what has been added to the "My Library" is also possible.

The search option makes the e-Library mobile application more user friendly and effective system. The user can enter the title of what they want to search and play it from there without having to go through the full library in search one specific item.

6. Conclusion and Future Work

A. Conclusion

The "Story Catcher" e-Library mobile application provides kids with a wide range of books, poems, and songs in both English and Sinhala Languages. Providing the users with a seamless user experience and kid friendly learning environment. Improving a child's imagination and cognitive development, as well as their early language and literacy development, is among the points that will help our users with our mobile application. "Story Catcher" is an age-appropriate kid friendly e-Library mobile application that enables the parent to set a screen time and avoid the kid from overusing the mobile application.

When considering a mobile application, it is required to develop furthermore, update and add new features to it. If not the user's interest towards the application tends to reduce. With growing technologies and introducing new trends to the market, it is a must to update a kid's mobile application like "Story Catcher".

The current mobile application supports only the Android operating system. Develop an Apple IOS-compatible mobile application as a future enhancement. By using frameworks like React Native and Flutter, the mobile application can be developed so that it is compatible with both IOS and Android OS.

It is an added benefit for the user and development team when an Artificial Intelligence (AI) feature is added to a mobile application. Adding a content recommendation feature to the mobile application so kids can access more content based on their preferences. Machine Learning is a branch of AI. By applying the concepts of machine learning such as Artificial Neural Network (ANN) and Deep Learning the content recommendation feature can be developed in the future. This feature will provide a better user experience and will help the development team when adding new content to the database.

Algolia is an AI-driven search and discovery platform that enables to create cutting-edge customer experiences for mobile applications. With the growth of the mobile application and increasing content, an AI-driven search API will provide a better search function and make it easier for users to find what they are looking for by just entering a few keywords. The Algolia API is available only for the Firebase "Blaze" which is a pay as you go plan. The current mobile application uses the Firebase "Spark" which is a free plan. With the growth users, an upgrade to the "Blaze" plan is possible. The Algolia search function can then be added as a future enhancement to the mobile application to enhance the user-friendliness of the mobile application.

An offline mode where the user can play any book, poem, or book that has been downloaded can be included as an additional future work. Voice search function so that the user voice out a keyword or title of what they want to search, and the voice search function will take over from there onwards. This feature too is to be added in the future. A monthly subscription fee will be charged from the registered users. The first month will be free, but once the month is over the user must pay their subscription fee. Secure payment gateways will be implemented to ensure the security and confidentiality of subscribed users. This too is a future enhancement.

References

"Epic - Kids' Books & Reading", App Store, 2021. [Online].Available:https://apps.apple.com/us/app/epic-books-for-kids/id719219-382.

"Let's Read | Children's Books | Free to Read Download Translate", Let's Read, 2021. [Online].A vailable:https://reader.letsreadasia.org/about.

"Little Stories. Bedtime books", App Store, 2021. [Online].Available:https://apps.apple.com/app/apple-store/id977016099?mt=8.

Picton, I., 2014. The Impact of ebooks on the Reading Motivation and Reading Skills of Children and Young People. National Literacy Trust,.

Play.google.com,2021.[Online].Available:https://play.google.com/store/apps/details?id=com.getepic.Epic "Epic - Kids' Books & Reading", App Store, 2021. [Online]. Available: https://apps.apple.com/us/app/epic-books-for-kids/id719219382.

Play.google.com,2021.[Online].Available:https://play.google.com/store/apps/details?id=com.skc.smartkidzclub&hl=en&gl=US.

Play.google.com,2021.[Online].Available:
https://play.google.com/store/apps/details?id=io.ionic.prog5e8abd4cb375235113d3b37d&-hl=en&gl=US.

Play.google.com,2021.[Online].Available:https://play.google.com/store/apps/details?id=org.asiafoundation.letsread&hl=en&gl=US
.
"Read to Me: Kids Books Library", App Store, 2021. [Online].Available:https://apps.apple.com/us/app/smart-kidz-club-read-to-me/id1459753862

Schanck, J. and Waller, M., 2013. The Impact of Audio Books on Middle School Students with a Mild Intellectual Disability. The Corinthian, Vol. 14 , Article 1.

Vooks — Storybooks Brought to Life", Vooks, 2021. [Online]. Available: https://www.vooks.com/.
Play.google.com,2021.[Online]. Available:https://play.google.com/store/apps/details?id=com.vooks&hl=en&gl=US.
"Vooks",AppStore,2021.[Online].Available:https://apps.apple.com/us/app/vooks/id1435813450.

Wängberg, M., 2012. Developing Mobile Applications For Children (Bachelor's thesis, Chalmers University of Technology).

Author Biography

MTA Deen is currently a BSc. Computer Science undergraduate in the Department of Computer Science, Faculty of Computing at General Sir John Kotelawala Defence University.

DSS Jithmisha is currently a BSc. Computer Engineering undergraduate in the Department of Computer Engineering, Faculty of Computing at General Sir John Kotelawala Defence University.

PDCJ Paranagama is currently a BSc. Software Engineering undergraduate in the Department of Computer Science, Faculty of Computing at General Sir John Kotelawala Defence University.

HHAMI Hettiarachchi is currently a BSc. Software Engineering undergraduate in the Department of Computer Science, Faculty of Computing at General Sir John Kotelawala Defence University.

Mrs. WPJ Pemarathne is a Senior Lecturer Grade II of the Faculty of Computing, General Sir John Kotelawala Defence University. She holds a Master of Philosophy in University of Sri Jayewardenepura and Master of Science in Computer and Network Engineering- Sheffield Hallam University (UK) and Bachelor of Science Degree in Information Technology (Computer Systems and Networks) in Sheffield Hallam University (UK) Her main research interests include Applications of Swarm Robotics, Artificial Intelligence and Robotics, Mobile and Wireless Communications, Network Security, Evolutionary Computing, and Internet of Things.