

Developing E-learning System to Support Visual Impairment during Covid-19 pandemic

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Abstract

E-learning is a common tool to support the education in variety of scenarios. As the education contents can be prepared by the group of specialists, but the skilled teachers are limited in remote area. Also, the contents in most curriculum are planned to distribute to limited skilled people. The gap of education can be full-filled with E-learning system. However, the conventional E-learning is high-cost system and not appropriated for rural area. Also, open-source system is complicated to implement and configure in dedicated curriculum.

This paper is proposed the customized design of E-learning system for supporting visual impaired student with dynamic design during Covid-19 pandemic. This paper shows the development that is based on the open-source system that is customized for the visual impaired student. The system is to support restricted budget study group in broad area where it can be customized to the study student group. The limitation has challenged the research to share and test among the stakeholders. The system is designed and implemented from actual requirements from teachers and students in university level.

The evaluation is based on comparison between conventional study method and proposed e-learning system in same semester. The developed system built on text-to-speech, simple design and customized UX/ UI. As a result, the result show student involvement and deliver more contents and knowledge to the visual impaired students. The feedback from actual usage also is evaluated.

Keyword: E-learning, Android, Visual Impaired, Covid-19.

Introduction

Electronic learning (E-learning) is a general system to support the learning process and assist the contents delivering to the specified learner. The key features of E-learning are to let learner access contents promptly with less constraints e.g. remote area, limited time, lack of teacher and large number of learners. Since network performance and equipment are easily access currently, a number of learners' request more of E-learning system. Also, learners expect to use E-learning for knowledge sharing and on-demand contents.

Visual Impairment can be categorized into several sections (blurred vision, color blindness, loss of vision etc.), to develop the e-learning system requires the system to support from blurry visual to zero visual students. As existing commercial system has a high cost to purchase where the open source has a very limited support especially for visual impaired students. The challenge is to reduce the gap between these commercial and open-source system that can practically use in university level. The design is based on high contrast display, font sizing, mono color, and text-to-speech assistant.

This paper shows the customized solution of E-learning system that is based on open-source platform and implemented with text-to-speech, simple design and customized UX/UI for specified need (visual impaired students). The solution is targeted for existing Thammasat students for groups of 10 students. The system is developing along with study semester, so the students can compare the conventional method with proposed system. At the end, the result is evaluated and compare with the study method previously.

E-LEARNING SYSTEM

E-learning is shown as critical system for contents sharing in business, research and academic. Since the market share of E-learning system reached \$2 trillions in 2001, many organizations implement the system for accessible and extra class support (Cisco Systems, 2001; Fry, 2001)

The main benefit of E-learning system is cost effective, flexibility, accessibility, and contents distribution. As the system are contents centralized and using the technology platform for access anywhere-anytime. Then overall, it reduced the cost of staff, operation task and open the opportunity to more people (Furnell et al., 1998) It also adds more

features that can provide online chat, AI enquiry, reminder, online quiz, and contents suggestions.

In general, large system is approaching with framework (Alexander, 2001; Garrison & Borgia, 1999) As developing time can be reduced significantly by using the built-in library. The security is conformed by the framework library as well as updating regularly with framework update. The important key is maintenance as framework using the standard model following with guidance.

The one of challenge of implementing E-learning is cost that increased 83 percent from 1998-2003 (Lance, 2000) his is a struggle for many organizations especially in education system. However, the need of E-learning also pushes to one of the largest share markets (Henry, 2001) For, specific small organization and limited budget company are difficult to access to the commercialized platform as well as the open-source system also required the skilled person to configure and understand that need follow the scheme of open-source package.

Text-to-speech

As text-to-speech has been developed for support need and assisted to deliver contents to audience that assist the general case use and the special need for visual impaired person (Isewon, Oyelade, and Oladipupo, 2021) as shown in Figure 1. The method has been developed with support new equipment and software that the technology is mainly built on composed words and composed phonemes (Raiyetunbi, Jude, and Emmanuel, 2020) as shown in Figure 2. The result is synthesizer that process the word to near natural language.

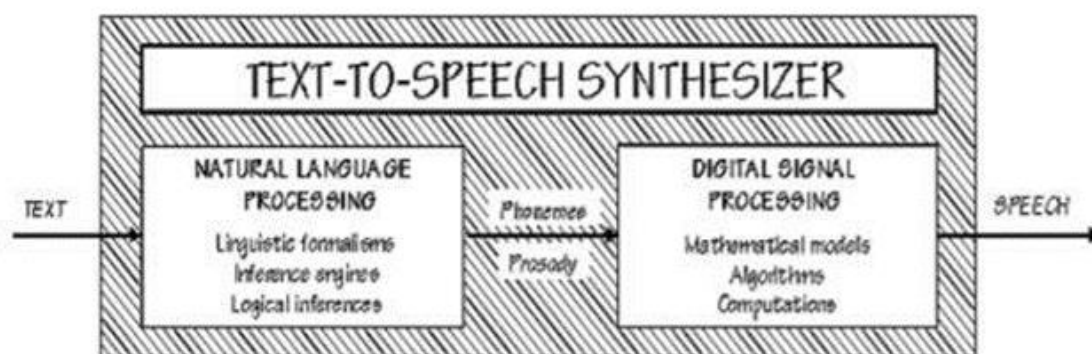


Figure 1 Text-to-speech (Isewon, Oyelade, and Oladipupo, 2021)

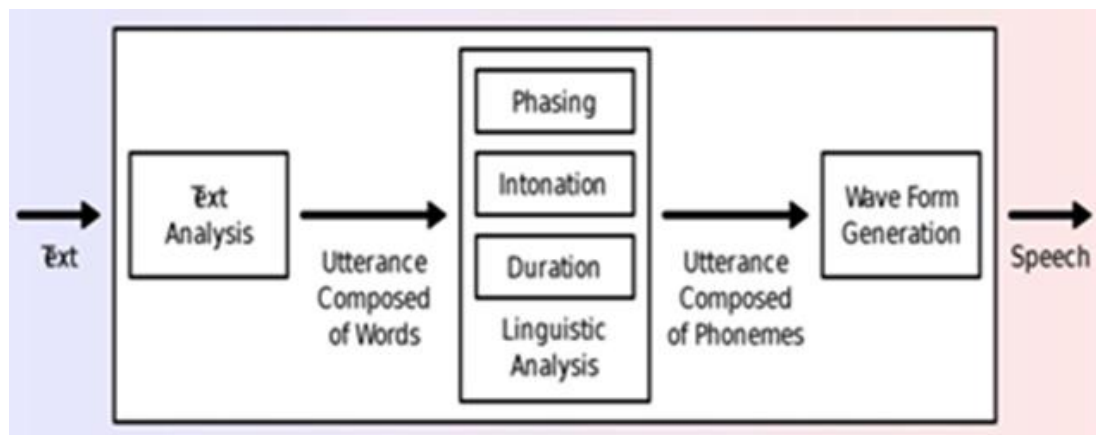


Figure 2 Text-to-speech System (Raiyetunbi, Jude, and Emmanuel, 2020)

FRAMEWORK

Android framework is a structure that prepare for programmer to develop application. Adobe Illustrator and Figma are the of tools to design on UI and character based. SQLite is use for database of quiz and contents storage. This assist for both user and backend side to communicate and interact and share contents over the network. Most of Android framework is based on JDK model, this scheme let programmer customize the framework to meet the requirement by using the universal programming language and layout organization that is compatible to designated devices. Also, most of the framework is based on open source, so it can minimize the cost of license and maintenance. The common tools for development is Android Studio which is widely use and updated along with the android framework.

The advantage of using this framework is let the structure more robust and more secure from the prepared package compared to developing from bare bone. In addition, the framework has prepared the libraries and themes for developer to choose and apply. So, implementation can be rapid and more convenience to meet the requirement.

SQLite provides the up-to-date contents structure that can add, delete, and modify the contents of application on the fly. These support the upcoming contents update from the education curriculum.

The special request is also to add the simple design features. The project designs the main character model of the simple page and support the handle the flexible of mobile

device. This has been focused for visual impaired student to handle the learning by themselves.

PLANNING & DEVELOPMENT

This E-learning system is based on the actual case from Thammasat University. The group of students and teacher in 2020 is selected research group in this paper. The development and evaluation are also based on the actual activity that interacts with students. The design must be compatible to the new mobile devices (e.g. smart phone and tablets). The contents in each screen should be simplified with one main idea.

The purpose of this E-learning system is to support the actual class and student has sufficient knowledge in using computer technology. The requirement and design of this system is survey from in-class students.

As this system need to support visual impaired students, the UI has brainstorm with the user and concluded the need to use the text-to-speech module. In this system, all stakeholders are discussed in focus group and need to balance between instructor, student and family who support the student with lead to use the API to support the main contents similar to strategy in figure 3 (Wittawat Patcharinsak, 2017) As a result, students are required to access to most standard contents as deliver in actual classroom.



Figure 3 Text-to-speech API support (Wittawat Patcharinsak, 2017)

Requirement

- The system must be convenient for visual impaired student or family to apply and access.
- Students who do not enroll may apply and register for the interest class.
- Every user can browse the contents in subject.
- The interface should be kids friendly.
- The objective must follow the core curriculum.
- The quiz must the task of activities in the class.
- The flow of application should let the student feel enjoy.

Application Design

This application is focused to deliver standard contents to visual impaired students. As all stakeholder discussed in planning phase. The structure has been designed to support the need of all stakeholders. The ER diagram are also support from the need as shown in figure 4. Next, the user interface is also break into small step for user to follow step-by-step guideline which replaced overall view information in modern design as shown in Figure 5. Also, the main contents are brought to highlight focus which in main step e.g. lecture in audio file format and put in main focus of application and ready-to-play as shown in Figure 6.

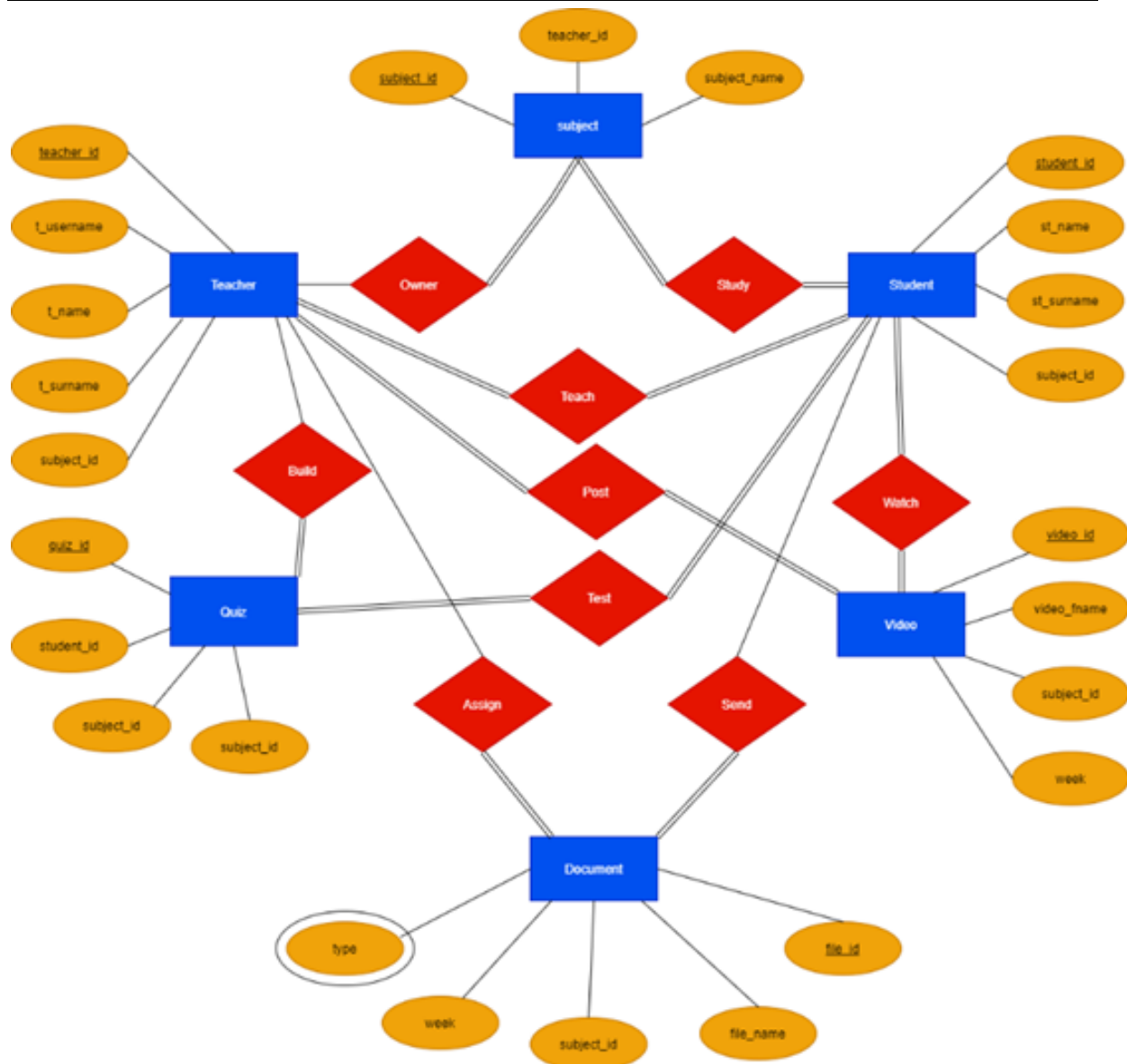


Figure 4 ER Diagram



Figure 5 Simple Contents Design



Figure 6 Main Contents are prioritized in audio format

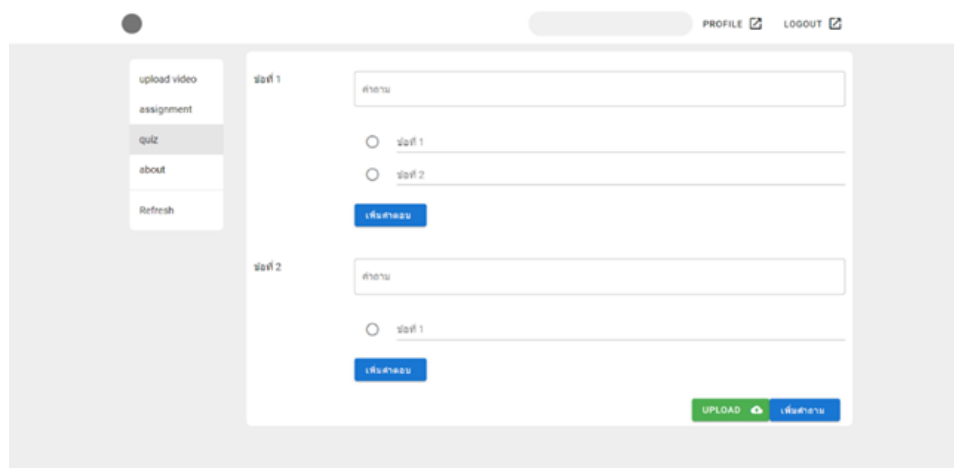


Figure 7 Quiz preparation for instructor

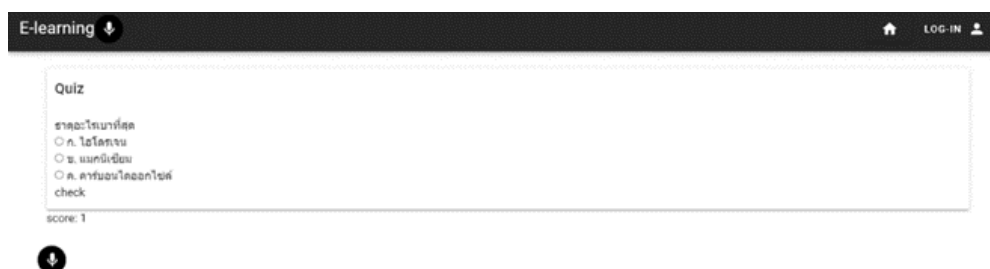


Figure 8 Quiz mode with voice command

In quiz section, the quiz is based on the learning knowledge by pulling up the question from SQLite and arrange by the selected topics. When the user finishes the quiz, simple mark output is given. The quiz allows the user to re-do in the case the gain the understanding. Figure 7 shows the instructor mode that teacher can create the quiz in standard mode to support all class students. However, figure 8 shows that in visual impaired student has quiz in text-to-speech and use voice command to do the quiz. The quiz is

based on the learning knowledge by pulling contents from SQLite and using Genymotion to adjust the result.

RESULT

The result of system is based on the actual testing in university students from Thammasat University. The group of 10 visual impaired students are using this application along with class study and giving the test result and feedback as follows:

Administrator mode:

- Log-in to the system.
- Registering to the system.
- Access to E-learning contents & downloadable contents.
- Some E-learning subject provide optional quiz.
- Search function.
- Forum for learner to share/discuss knowledge.
- File organization Add, Modify, Delete.
- Profile management.
- History organization (Review Content).

User mode:

- Topic selective.
- Contents Summary
- Quiz
- Simple UI
- Design from user requirements.

The test result is based on the given time allocation of teacher to the students where the two weeks allocation on everyday task. The survey was given as anonymous via the survey form with rating scale, log data from server and cross check the result with private workshop. The average time per slot is 88 minutes as shown in table 1. Also, the support family also given the involvement and provide the feedback result for overall usage as shown in table 2.

Table 1 Summation of Usage Time

	Male	Female
Average usage per week	9	9.7
Average Time per usage in class (minutes)	82	94
Willing to continue to use.	95.71%	97.5%
Average time per usage at home (minutes)	58	64

Table 2 Feedback Result

Feedback (out of 5)	Average	SD
Quality of content	3.95	0.1
To support the class knowledge	3.95	0.1
Quality of application	3.93	0.15
Effective to learning process	3.97	0.07

DISCUSSION

As this system is created based on the actual user (visual impaired students) requirement and reviewed by the same group student, our purpose is to gain more contribution of student. The objective is gaining more attention and support the in-class education. The result is based on survey form, log data from server and workshop.

As shown in Table 1, our objective is to evaluate the contribution of learner. As the learners does not intention to use the E-learning before this paper. To motivate learners to contribute the new learning tools are shown in visual impaired students. The result also shows the continuous of the involvement for all study period in both school and home. This usage time includes both quiz and learning contents based on 2020 students.

Many involvements also require network traffic and computer resource. With this need, in our system has a large scale of computer resource in research lab. However, in real case, the system requires implementation resource in the organization. Therefore, with limited resource and recent technology, cloud server is suggested for the proposed system.

The quality from feedback is shown as above average due to the design and requirement of their choices, however they suggest that the improvement on the next

version of application would be expected. The functions from administrative and user mode also support the user as need as show in the feedback.

Overall, the customized system shows the significant improved in main objective of E-learning system. The data and rating is improving from user engagement as well as the feedback result. This also provides the solution that new trend of users needs the information in their own need format and their own need. The alternative solution is served their task achieved in this area.

Conclusion

E-learning is challenged in every organization to customize for appropriate for each organization. The difference in objective, members' background and knowledge leads to different expectation. The customization system is a solution with a high cost of out-of-the-box software.

This paper suggests the customized E-learning system based on Android framework. The specific learning group are based visual impaired university students. The features of this system are contents sharing, online quiz, and feedback system to the responding teacher in school. The implementation of deployed system is based on user's requirement that tend to meet with expectation. The limitation has challenged the research to sharing and testing among the stakeholders. The developed system built on text-to-speech, simple design and customized UX/UI shows that student has more engagement and deliver more contents and knowledge to the visual impaired students.

The trend of user involvement is improving the participation in most of area especially support special need students.

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