E-learning Model for Blind Disabilities with Text to Speech using NLP

Inayatulloh
Information Systems Department
School of Information System
Bina Nusantara University
Jakarta, Indonesia 11480
Inay@binus.ac.id

Ade Fadli Fachrul
Dirosat Islamiyah High School of Da’wah Al Hikmah
Jakarta, Indonesia

Sugeng Riyanto,
STIE Pertiwi
Bekasi, Indonesia
sr7752413@gmail.com

Rozali Toyib
Universitas Muhammadiyah
Bengkulu, Indonesia
rozalitoyib@umb.ac.id

Rivaldhy N. Muhammad
Study Program of Law, Faculty of Law, Social and Political Sciences
Open University, Indonesia
valdhymuhammad1@gmail.com

Elvia Puspa Dewi
STIE IGI
Jakarta, Indonesia
elviapuspa2018@gmail.com

Abstract
Some of the advantages of E-learning lead to the implementation of e-learning at different levels of education and increase the effectiveness and efficiency of the learning process. However, e-learning cannot be implemented properly for disabilities, one of which is blind disability. The purpose of this research is to build an e-learning model for blind disabilities so that the knowledge transfer process can be carried out effectively and efficiently for the blind disability community. The research method uses a qualitative approach by interviewing disability and experts to get problems and solutions as considerations for creating a model. The result of this research is an e-learning model for blind disabilities.

Keywords
E-learning, Blind disabilities, Model, NLP
1. Introduction
Inayatulloh and Hendra (2021) explain E-learning, also referred to as online learning or electronic learning, is the acquisition of knowledge which takes place through electronic technologies and media. In simple language, e-learning is defined as “learning that is enabled electronically”. Typically, e-learning is conducted on the Internet, where students can access their learning materials online at any place and time. E-Learning most often takes place in the form of online courses, online degrees, or online programs. The advantage of E-learning saves time and money, leads to better retention, consistent, scalable and offers personalization.

Uju and Olofu (2020) observed The benefit of distance instruction or learning as shown can be perceived from three perspectives. From the student’s point of view, it implies flexibility from a few of the limitations of time, of put and nation, and of age with more prominent get to more openings for proceeding teaching (Baber 2020).

E-learning gets to be a need since of the a few benefits it produces, such as giving a special opportunity for learner control. Learner control for the most part alludes to “a mode of instruction in which one or more key directions choices are appointed to the learner”

But the advantages of e-learning are only for physically normal people but cannot be used by disabled people. So, we need an e-learning model that can be used by people with disabilities. People with various types of disabilities such as psychological / psychiatric disabilities, Health / medical related disorders, Deaf / hard of hearing, Visual impairments: low vision, Completely blind. Then the model used will be different depending on the type of physical disability that the person has. The next challenge is to create an e-learning model. The e-learning model built on this research is specifically for the blind. Inayatulloh et al. (2021) find physical limitations for people with disabilities cause many obstacles in increasing knowledge through e-learning. E-learning is very effective as a knowledge transfer tool for people without disabilities but not for people with disabilities. The purpose of this research is to build an e-learning model for people with blind disabilities with an approach to using hardware as a tool for the physical limitations of people with visual impairments.

2. Literature Review

E-Learning
Ananga et al. (2020) mentions the origins of the term e-Learning is not certain, although it is suggested that the term most likely originated during the 1980’s, within the similar time frame of another delivery mode online learning. While some authors explicitly define e-Learning, others imply a specific definition or view of e-Learning in their article. Njoku et al. (2018) observed that e-Learning as strictly being accessible using technological tools that are either web-based, web-distributed, or web-capable. The belief that e-Learning not only covers content and instructional methods delivered via CD-ROM, the Internet or an Intranet. Singh et al. (2019). E-Learning is not only procedural but also shows some transformation of an individual's experience into the individual's knowledge through the knowledge construction process.

Blind Disabilities
Nayar et al. (2021) and Taufick (2021) mention People with disabilities, and in particular people who are blind or vision impaired, are not embracing computing and Internet-related technologies at the same rate as the able-bodied population. The arrival of mainstream computing and assistive technology creates the potential for blind and vision impaired people to gain access to resources previously denied. The development of the personal computer, for example, meant library books could be scanned into a computer and then read aloud via a voice synthesizer. But this is a new problem for blind people with digital formats, making it more difficult for people with disabilities to access information in digital form and all e-learning content in digital format. Thus, this research builds an e-learning model for the visually impaired so that the visually impaired can increase their knowledge via e-learning.

Text to speech and Natural Language Programming
Allen (1987) define that NLP is a branch of computer science, linguistics, and artificial intelligence that studies the interactions between computers and human (natural) language, specifically how to program computers to process large amounts of natural language data. The result is that the computer is able to "understand" the contents of the document, including the nuances of the language in it. Text To Speech Conversion Using NLP means converting text to the voice speech using NLP. NLP is a field of artificial intelligence that gives the machines the ability to read, understand, and derive meaning from human languages. Top MNC Companies and Start-up companies are putting
more effort and millions of money in the NLP field. Everywhere is a data scientist is trying to understand the NLP domain and its process with excellent application. Most of the industry trying to automated with NLP. Rubun (1981) define that speech synthesis is the artificial production of human speech. A computer system used for this purpose is called a speech computer or speech synthesizer, and can be implemented in software or hardware products. A text-to-speech (TTS) system converts normal language text into speech; other systems render symbolic linguistic representations like phonetic transcriptions into speech. The reverse process is speech recognition. Synthesized speech can be created by concatenating pieces of recorded speech that are stored in a database. Systems differ in the size of the stored speech units; a system that stores phones or diphones provides the largest output range, but may lack clarity. For specific usage domains, the storage of entire words or sentences allows for high-quality output. Alternatively, a synthesizer can incorporate a model of the vocal tract and other human voice characteristics to create a completely "synthetic" voice output.

3. Methods
This research begins with identifying problems related to e-learning for blind people. Based on observations of blind people when using e-learning, the main obstacle is the difficulty of interacting with the e-learning system. Meanwhile, 2-way interaction is an important part of e-learning. The next stage of this research is to identify hardware that can be used by blind people and an e-learning system to create 2-way interaction. The next stage is to design a standard interface for e-learning software and hardware that is integrated into a unified system. The final stage of this research is to build an e-learning model for the blind.

Figure 1. Research Method
4. Results and Discussion

Figure 2 describes the e-learning model for the visually impaired. As the main part of e-learning is the LMS or Learning Management System where this system functions to manage all activities related to learning activities in e-learning such as data or residual information, teachers, course materials, schedules and others. The second main part of this model is the conversion process from the course material database into sound files that will be used by the visually impaired. The following are part of the conversion process:

a. Text Normalization
Text normalization is the process of transforming text into a single canonical form that it might not have had before. Normalizing text before storing or processing it allows for separation of concerns, since input is guaranteed to be consistent before operations are performed on it. Text normalization requires being aware of what type of text is to be normalized and how it is to be processed afterwards; there is no all-purpose normalization procedure.

b. Letter to Phoneme
Letter-to-phoneme conversion is often also referred to as “letter-to-sound conversion” or “grapheme-to-phoneme conversion” (commonly abbreviated as g2p conversion). I therefore want to define very briefly the notions of “letter”, “grapheme”, “phoneme” and “sound”. A letter is an element of the alphabet of a language (I am only considering languages with alphabets here). There are different definitions for a grapheme. In this thesis, I refer to a grapheme as a string consisting of one or more letters that together correspond to exactly one phoneme. A phoneme is an entity that is a transcription of a sound which is nearer to the pronunciation of a word than its orthographical representation. It is defined by its ability to distinguish relevantly different sounds in a language. Phonemes differ from phones in that they are relative entities that describe differences which are significant within a language.

c. Exception Dictionary Lookup
Is a part of Natural Language programming that contains a collection of several exception conditions that are used in the process of converting text to sound?

d. Prosody Generation
Naturalness in Text-to-Speech (TTS) systems is very important in achieving high quality waveform. The naturalness of the waveform is highly correlated to phonetic coverage and prosodic features such as loudness, duration and pitch. The TTS system to which the prosodic information is added, is a concatenative synthesizer based on diphones. Intelligibility and acceptable naturalness of the synthesized speech have been confirmed by subjective listening tests.

e. Speech Parameter Generation
The speech parameter generation algorithm considering global variance (GV) for HMM-based speech synthesis proved to be effective against the over-smoothing problem. The Hidden Markov Model (HMM)-based speech synthesis has been widely used in recent years. In this method, pitch, spectrum and duration are modelled simultaneously within a unified framework. By taking account of constraints between the static and dynamic features, smooth speech parameter trajectories can be generated. The synthetic speech is highly intelligible and smooth.

f. Speech Waveform production
Speech processing algorithms rarely work directly with the (sampled) speech waveform but rather with a sequence of quantified features that are extracted from the signal, usually at regularly-spaced intervals. In a typical scenario, features are computed periodically in time over 256-point frames that are intentionally overlapped by 128 samples. For a 10-kHz sampling rate, this represents feature computations using 25.6 ms segments of speech that overlap by 12.8 ms as the processing moves through time. Using the rule of thumb that speech signal dynamics remain stationary for blocks of 10 to 20 ms, the frame duration is chosen with this in mind, balanced against the need to represent the waveform with the smallest possible number of feature computations (for economy of computation and storage, adherence to bandwidth requirements, and other factors).
5. Conclusion
The use of Natural Language Programming combined with e-learning will create many opportunities and challenges where in this paper the focus is on the e-learning model for the visually impaired. Obstacles faced by blind people to gain knowledge like people with normal vision will disappear because people with visual impairments will get the same information and knowledge as people with normal vision by using text to speech technology which is part of NLP because this system will convert all e-content -text-based learning into speech.

References

Bibliographies

Inayatulloh SE. MMSI, CDMS. CSCA is a lecturer at Bina Nusantara University, School of Information System Jakarta Indonesia and also a doctoral candidate of computer science, experienced in managing systems in the retail, automotive, convection and education industries. research domain in e-learning, e-business, e-commerce, cloud computing, IoT and block chain technology.

Ade Fadli Fachrul, Master of Communication & Property Management. He had experience working as lecturer at Sekolah Tinggi Ilmu Dakwah Dirosah Islamiyah Al Hikmah (STIDDI AL HIKMAH) Jakarta. He graduated from Bachelor Degree in Nasional University, Jakarta, Master Degree in Universiti Teknologi Malaysia and Mercu Buana University, Jakarta. He has been more than 20 years of lecturer experiences.

Sugeng Riyanto, found that my passion was to become an educator. I decided to take a master's degree at the university of IPB by taking a concentration in Small and Medium Industry Management (MPI). It was a big decision in my life that would change everything. I am currently a lecturer at the College of Economics (STIE) PERTIWI Bekasi, I have started the teaching profession since 2014 until now. Apart from being a lecturer, I am also the deputy principal of the industrial relations field at a private vocational school in Bogor district. I have a responsibility to establish relationships and cooperation between schools and the industrial world, agencies, and other institutions, both government and private institutions.

Rozali Toyib is a lecturer at the University of Muhammadiyah Bengkulu in the Faculty of Engineering, various activities have been carried out such as seminars in the IT sector, Applied Research in the IT field, IT workshops and is active in various professional organizations as an administrator of the Bengkulu Branch of the Indonesian Informatics Expert Association (IAII), Assistant for the Program Centre of Excellence Vocational High School (SMK-PK) and is active as a coach for student affairs in student creativity programs.

Rivaldhy N. Muhammad is a Lecturer at the Open University which is one of the State Universities in Indonesia. holds a Bachelor of Laws degree at Khairun University Ternate and a Masters degree at Janabadr a University Yogyakarta. Since becoming a Lecturer in 2018, he has been assigned to Jayapura Papua Open University as a Lecturer in the field of Legal Studies who always provides teaching and guidance to students who need good knowledge. Before becoming a lecturer, Rivaldhy N. Muhammad was a lawyer who always helped people who needed legal aid services.

Elvia Puspa Dewi, master of accounting. She had experience working in government-owned financial institutions. He graduated from Gunadarma University with a bachelor's degree and a master's degree in accounting from the STIE YAI. Elvia Puspa Dewi is currently a lecturer at the Faculty of accounting at STIE IGI. She has more than 10 years of lecturer experience.