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

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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.

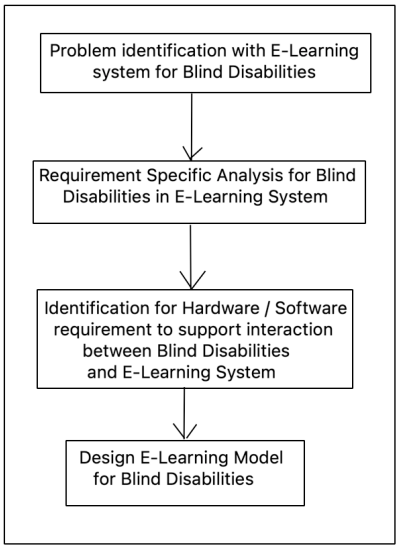

Figure 1. Research Method

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 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).

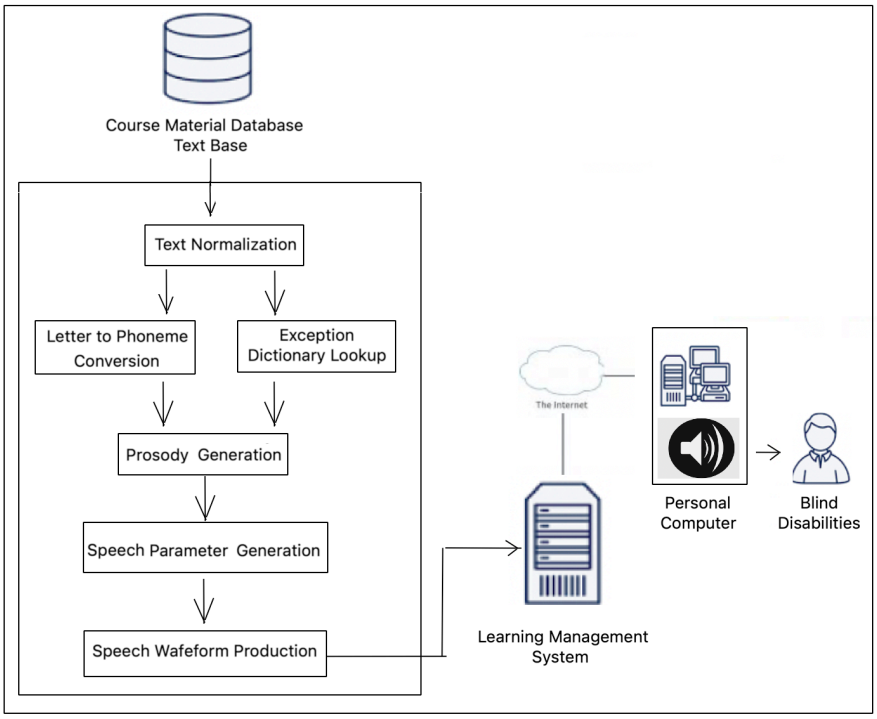

Figure 2. E-learning Model for Blind Disabilities

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.

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