

ENGLISH LEARNING SYSTEM USING SPEECH RECOGNITION FOR VISUAL  
IMPAIRED USER (ELSRVI)

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## **Abstract**

English Learning System Using Speech Recognition for Visual Impaired User (ELSRVI) is a prototype which is embedded with speech recognition and aimed at Visual impaired user that have the speaking and hearing ability. This system is user friendly since user do not need to navigate the computer by using normal keyboard. Besides that, this system is also created to fulfill all the objectives of the system. The objectives are to develop a prototype to determine English learning system using speech recognition engine for visual impaired user to get accessed to computer through speech and to identify the suitable techniques and software to create the English learning system using speech recognition engine for visual impaired user. So, the interaction between humans and computers will be more natural if computers are able to understand the speech and recognize it. The technique that will be used is in develop the system is Linear Predictive Coding (LPC). The methodology use is Rapid application Development (RAD). This system is also created due to improvement in the new technologies nowadays which is more enhanced and mainly to overcome the problem faced by visual impaired user in their education life. Finally, in this report will discuss on the preparation and analysis that have been done in order to develop this system. A complete reference and research details have been inserted in this document. This document will be a quick reference to refer on the specification and requirements of the system.

## **Abstrak**

Bahasa Inggeris Sistem Pembelajaran Menggunakan Pengiktirafan Ucapan untuk pengguna Visual Cacat (ELSRVI) adalah prototaip yang mengandungi pengiktirafan ucapan dan bertujuan untuk pengguna cacat penglihatan yang mempunyai keupayaan bercakap dan mendengar. Sistem ini adalah mesra pengguna kerana pengguna tidak perlu untuk mengemudi komputer dengan menggunakan papan kekunci biasa. Selain itu, sistem ini juga diwujudkan untuk memenuhi semua objektif sistem. Objektif adalah untuk membangunkan satu prototaip untuk menentukan sistem pembelajaran Bahasa Inggeris menggunakan ucapan enjin pengiktirafan untuk pengguna cacat penglihatan untuk akses komputer melalui pertuturan dan untuk mengenal pasti teknik dan perisian yang sesuai untuk mewujudkan Sistem pembelajaran Bahasa Inggeris menggunakan ucapan enjin pengiktirafan untuk pengguna cacat penglihatan. Jadi, interaksi antara manusia dan komputer akan menjadi lebih semula jadi jika komputer dapat memahami pertuturan dan mengiktiraf. Teknik yang akan digunakan dalam membangunkan sistem ini adalah ramalan Coding Linear (LPC). Penggunaan metodologi Pembangunan permohonan Rapid (RAD). Sistem ini juga diwujudkan akibat peningkatan dalam teknologi masa kini yang lebih dipertingkatkan dan terutamanya untuk mengatasi masalah yang dihadapi oleh pengguna cacat penglihatan dalam kehidupan pendidikan mereka. Akhirnya, dalam laporan ini akan membincangkan mengenai penyediaan dan analisis yang telah dilakukan dalam usaha untuk membangunkan sistem ini. Sebuah rujukan yang lengkap dan butir-butir penyelidikan telah dimasukkan di dalam dokumen ini. Dokumen ini akan menjadi rujukan yang cepat untuk merujuk kepada spesifikasi dan keperluan sistem

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## **CHAPTER 1**

### **INTRODUCTION**

This chapter is the introduction about the project that had been developed. It consists of introduction, problem statement, objective, scope, and thesis organization.

#### **1.1 Background**

According to the World Health Organization (WHO), estimates that about 314 million people are visually impaired and approximately 14% (45 million) are blind and the other 86% are low vision. Most people who are visually impaired causes by cataracts (a cloudy area that forms in the lens of the eye), uncorrected refractive errors, glaucoma, and macular degeneration [1]. According to the International Classification of Diseases -10 (Update and Revision 2006), there are four levels of visual function that are normal vision, moderate visual impairment, severe visual impairment and blindness. Moderate visual impairment combined with severe visual impairment is grouped under the term “low vision”. Low vision taken together with blindness represents all visual impairment [2].

Visual impaired people use other sense organs such as touching, smelling and hearing to stimulate the brain to understand the surroundings. Object recognition is a problem for them. In learning aspect, hearing is very important method to input the information for them. According to the National Network for Child Care (NNCC) and The Americans with Disabilities Act, to help a blind kid, the guide can provide activities with sensory experiences. Children with visual disabilities learn through hearing and touch. Sand and water play, collages, play dough, and finger painting are good learning activities. In addition, guidance can read aloud stories that have a two predictable story line. Stories that offer interesting descriptions of actions or objects are suitable them [3].

Academician should not modify academic standards for visually impaired students. All students must meet the required level of understanding and performance competencies for the course, although visually impaired students may need to be modifications in the evaluation or testing method. Students with visual impairments are constantly challenged by classroom instructional strategies. Although they can easily hear lectures and discussions, it can be difficult for them to access class syllabus, textbooks, overhead projector transparencies, maps, videos, written exams, demonstrations, and films. A large part of traditional learning is visual. Fortunately, many students with visual disabilities have developed strategies to learn. [4]

Recent years have seen the development of several technologies designed to assist vision impaired people, both for obstacle avoidance, and for learning purposes. The research described here focused on the development and evaluation of a prototype of English learning system that makes use of speech recognition. People with disabilities meet barriers of all types. However, technology is helping to lower many of these barriers. By using computing technology for tasks such as reading and writing documents, communicating with others, and searching for information on the Internet, students and employees with disabilities are capable of handling a wider range of activities independently. Specific technologies and approaches are used to help these visual impaired users such as speech recognition. Speech recognition simply is the process of converting spoken input to text and sometimes referred to as speech to text or vice versa and key enabling technology that will permit natural interaction between humans and intelligent machines [5].

There are many multimedia coursewares in the market for various age of user. Instead of considering user's age and physical conditions, disabilities factor also have to be taken under consideration where disable people also can use the system. In this English learning skills system, hearing and speaking method is used to communicate with the user and to make their daily routine easier. This English Learning System Using Speech Recognition for Visual Impaired users (ELSRVI) is focusing on hearing and speaking where speech technology (speech to text) which had been developed by using Microsoft Speech Application Programming Interface (SAPI) since user is unable to see the computer screen clearly. Incredibly, this leads to the discussion about ELSRVI which will be user friendly.

## **1.2 Problem Statement**

In our daily life, we use many online systems and new technologies in order to improve the quality of our life but most of them are not user friendly for those visual impaired users who face difficulties in typing and also encounter difficulties in expressing their spoken words in text or documents form. Besides that, most of visually impaired students face difficulties in learning process and using online systems. As we know that learning process of education is very important in a person life and through education a person can be successful in the life. For these visual impaired users books or other hardcopy materials do not help much since it is in printed form. In addition, more man powers are needed to guide the visually impaired students in learning process. Therefore, to help the visual impaired students in learning and problem solving, by hearing and speaking method is choose for this multimedia learning process. This method more users friendly since user do not need to navigate the computer by using normal keyboard. Finally, this project is proposed in order to create a system that can be used by visual impaired user with giving speech command to the system and it is totally not suitable for those who experience the mute problem.

### 1.3 Objectives

This system is developed with several objectives, which are;

- i) To develop a prototype to determine English learning system using speech recognition engine for visual impaired user to get accessed to computer through speech.
- ii) To identify the suitable techniques and software to create the English learning system using speech recognition engine for visual impaired user

### 1.4 Scopes

The scopes of the ELSRVI project are:

- i) Project
  - a) Detect and recognize the speech.
  - b) Carried out in “ Control Environment”
  - c) Create a user friendly GUI to perform the speech signal analysis for the speech recognition purpose.
  - d) The tool to develop this learning system is Microsoft Visual Studio 2010 (VB.Net 2010).
  - e) Windows Speech Application Programming Interface (SAPI) as the programming engine.
- ii) The target User
  - a) Visually impaired (partially sighted, can speak and hear) people as the primary user
  - b) Normal user (tutor/assistant) as the secondary user to guide the new primary user on how to use the courseware

## **1.5 Thesis Organisation**

This thesis consists of six (6) chapters. Chapter 1: Introduction- This chapter is the introduction about the project that had been developed. It consists of introduction, problem statement, objective, scope, and thesis organization. Chapter 2: Literature Review- This chapter explained the case study of the project. There are 2 general structures of this study, the technique that has been used and the former system that are already created. Chapter 3: Methodology-The purpose of this chapter is to discuss the approach and framework for the project. Method, technique or approach that will be and will be used while designing and implementing the project will be included in the content. Justification and of method on approach used and hardware and software necessary is stated here. Chapter 4 - Implementation - This chapter discuss on how ELSRVI system had been developed in development environment structurally and logically. Chapter 5 – Result and Discussion- This chapter discussed on the results, data analysis or output produced as expected and the result is further discussed. Result analysis, project limitation and suggestion and project enhancement are contents for the chapter. Chapter 6-Conclusion-This chapter concludes about the entire system and explains briefly and summarizes the developed project.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter explained the case study of the project. There are 2 general structures of this study, the technique that has been used and the former system that are already created.

#### **2.1 Speech Recognition**

This section will firstly presents about the introduction to speech recognition, what is speech recognition, the definition of speech recognition, types of speech recognition, the advantages and disadvantages of speech recognition and other further information that will be helpful in the creating of the system



### **2.1.1 Introduction to Speech Recognition**

Speech recognition is the ability of a machine or program to identify words and phrases in spoken language and convert them to a machine readable format and known as automatic speech recognition, speech to text, or voice recognition or many more. The term "voice recognition" is sometimes used to refer to recognition systems where, the recognizing of the speaker can simplify the task of translating speech [6]. In other words, rather than using a keyboard to communicate with the computer, the user speaks commands into a microphone usually on a headset that is connected to a computer. By speaking into the microphone, users can do two things. First, they can tell their computers to execute commands such as open a document, save changes, delete a paragraph, and even move the cursor to all without touching a key. Second, users can write using voice recognition in conjunction with a standard word processing program. When users speak into the microphone their words can appear on a computer screen in a word processing format, ready for revision and editing [7].

Speech recognition process is performed by software component known as speech recognition engine. The primary function of speech recognition engine is to process spoken input, and give the output by translate it into text that an applicable understands. A speech recognition system consists of a microphone for the person to speak into, speech recognition software, a computer to interpret the speech, a good quality soundcard for input and output, and a proper and good pronunciation. Speech Recognition Grammar is a set of word patterns that direct the speech recognition system to respond to a human voice. This speech recognition grammar responds to the calls made by human beings in a predefined manner.

Overall speech recognition is an alternative to traditional methods of interacting with a computer, such as textual input through a keyboard and mouse input. It is an effective system that can replace, reduce the reliability on, standard keyboard and mouse input. Speech recognition has three types of speaker system which are speaker dependent system, speaker independent and speaker adaptive system.

### 2.1.1.1 Types of Speech Recognition

The speech recognition technology and systems can be categorized in several different classes by describing types of utterances they have ability to recognize. These classes based on the difficulties of Automatic Speech Recognition (ASR) model of voice recognition designed for dictation and can determine when a speaker starts and finish utterance. This software differs from previous models in that it does not strive to understand what is being said, only to identify the words spoken. Since many words in the English language sound alike, mistakes are easily made. ASR software is often found on digital voice recorders. The types of speech recognition that used are listed below [8and 9]:

a) Isolated Words

An isolated-word speech recognition system requires that the speaker pause briefly between words, whereas a continuous speech recognition system does not. Where, it usually requires each utterance to have quite or lack of audio signal on both sides of the sample window. It does not mean it accepts single words, but requires a single utterance at a time.

b) Connected Words

Similar to Isolated words, but allow separation of utterance to be run together with minimal pause between them.

c) Continuous Speech

The continuous speech recognition system understands words that are spoken in a normal manner and designed to understand a more natural mode of speaking. It is a more sophisticated form of voice recognition software, where in the caller can speak naturally to explain a problem or request a service. This program is designed to pick out key words or phrases and make a statistical best-guess as to what the customer wants. Speaking plainly aids voice recognition in identifying the need. This type

of system has a far more intensive database than discrete speech systems and is also referred to as natural language recognition.

d) Discrete Speech

In the discrete speech recognition systems, the dictator has to take a pause after every word spoken and are requiring the user to speak clearly and slowly and to separate words. It widely used for customer service routing. The system is speaker independent, but understands only a small pool of words or phrases.

e) Spontaneous Speech

At basic level, can be thought as speech that is natural sounding and not rehearsed. An ASR system with spontaneous speech ability should be able to handle a variety of natural speech features such as words being runs together, “ums” and “ahs” and even slight stutters.

f) Voice Verification or Identification

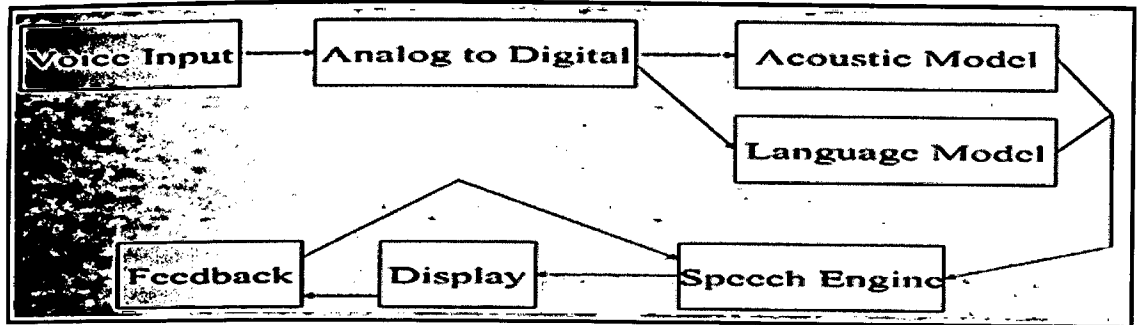
Some ASR has ability identify specific user but this documents doesn't cover verification or security systems.

### **2.1.2 How does speech recognition works**

First, to operate a computer through voice, the user must learn how to dictate in a word by word manner known as discrete speech. In other words, the computer cannot recognize individual words if they are spoken the way people usually speak in fluent sentences or continuous speech. Next, the user must teach the system to recognize his or her voice through a combination of training and usage. We all pronounce individual words in different ways, and voice recognition software cannot simply recognize everyone's voice right off and takes time.

So once when a person speaks, the vibrations are created and speech recognition technology converts these vibrations, which are known as analogue

signals into a digital form by means of an analogue-to-digital converter (ADC). This because when we speak through microphone the sound or from user is in analogue form and the computers don't understand analogue form because computers can only understand digital language so that's why the sound or input will be convert to digital form this process known as digitizing.



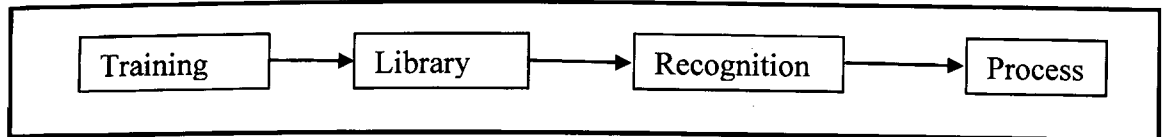
**Figure 2.1:** The diagram below shows the process of recognition [10]

From the diagram above after digitizing it send to two models which are Acoustic Model and Language Model. Acoustic Model created by taking audio recordings of speech, and their text transcriptions, and using software to create statistical representations of the sound that make up each word. It used by speech recognition engine to recognize speech. Language Model used in many natural language processing applications such as speech recognition tries to capture properties of language and predict the next word in speech sequence.

Speech engine has rather complex task to handle, that of taking the raw audio input and translating it to recognized text that an application understands. First thing when the input comes into recognition engine it not only contain data but also background noise and this noise can interfere with recognition process and speech engine must handle the environment within which the audio is spoken. So, it important and first job is process the incoming audio signal and convert it into a format best suited for further analysis [11]. Once the signals are fully processed in speech engine then it will be display as output and the feedback of the output will be sending and noticed the speech engine.

### 2.1.3 Main block diagram of speech recognition tool and techniques

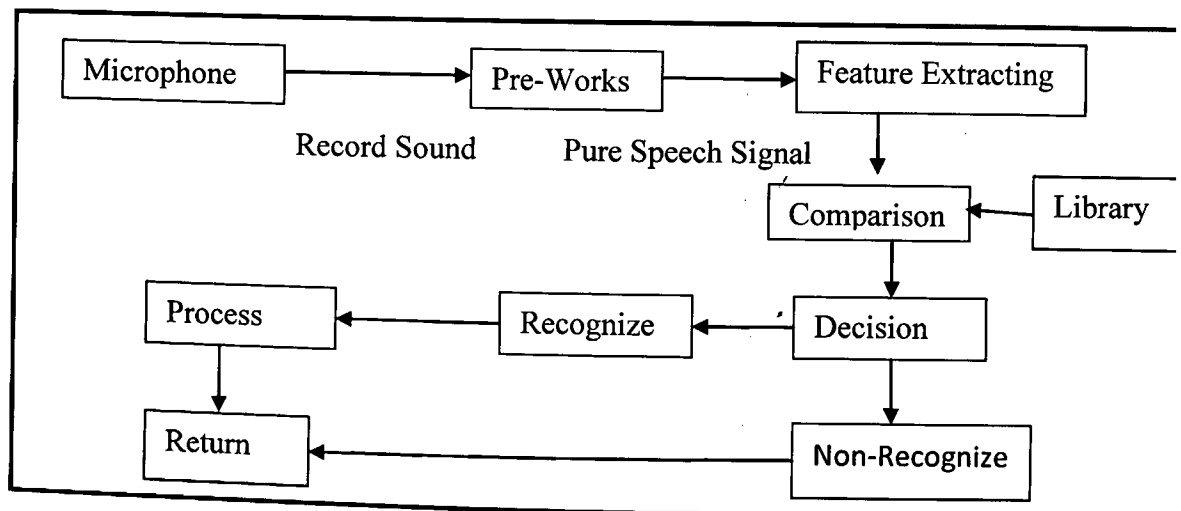
A speech recognition tool consists of four main parts which are training, library, recognition and process with different functions.



**Figure 2.2:** diagram of parts that involve in speech recognition

In training process the voice commands that are going to be used in recognition are defined to the system. Next, creating a library for training voice commands and stored in the library. The recognizing process, say a command and the sound from the commands are compare with the sounds of the compounds in the library. The last part is processing, while training system can also assign some functionalities to these commands. And processing is part where the function of the recognized command is operated.

The techniques that used in speech recognition are commonly used for this domain in the past which are Dynamic Time Warping (DTW), Hidden Markov Models (HMM), Linear Predictive Coding (LPC) and many more.



**Figure 2.3:** Speech signals main block diagrams [9]

### **2.1.4 Advantages and Disadvantages**

The Advantages are the people with disabilities can get benefit from the system and used it for many purposes. Other than that, Organization can increase productivity, reduce costs and errors. Finally, advance in technology that allows consumer and business to implement speech recognition systems at a relatively low cost.

The disadvantage is difficult to build a perfect system, conversations involve more than just words or non-verbal communication. Finally, filtering background noise is a task that can even be difficult for humans to accomplish. The future of speech recognition is accuracy will become better and better, dictation will gradually be accepted, and microphone or sound systems will be designed to adapt more quickly to changing background noise levels, different environments and with better recognition of extraneous material to be discarded.

## **2.2 Visual Impairment**

In this subtopic will be discussing about the definition of visual impairment, causes of visual impairment, who are the visually impaired users, the problem faced by this visually impaired users and the interface design that suits this visually impaired user systems and design using speech recognition for this visually impaired users.

### **2.2.1. Definition of Visual Impairment.**

Visual impairment is known as vision loss of a person to such a degree as to qualify as an additional support need through a significant limitation of visual capability resulting from either disease, trauma, or congenital or

degenerative conditions that cannot be corrected by conventional means, such as refractive correction, medication, or surgery [12]. Vision loss or known as visual loss is absence of vision where it existed before, which can happen either acutely or abruptly and chronically or over a long period of time. The term 'visual impairment' also refers to people with irretrievable sight loss and this simple definition covers a wide spectrum of different impairments. It does not include those whose sight problems can be corrected by spectacles or contact lenses, though it does include those whose sight might be improved by medical intervention. If you are short sighted or long sighted, but you can see normally when you put your glasses on or wear your contact lenses, you are not visually impaired.

Besides that, there are four categories of visual impairment such as partially sighted, low vision, legally blind and totally blind [13]. The partially sighted means that the person has some difficulty seeing and reading information, and requires special assistance with learning and reading. The partially sighted people faces visual problem that resulted in a need for special education which can help them learn and read through new technologies such as speech recognition, audio visual aids and many more. Next, is low vision to a severe visual impairment indicates a more serious visual impairment and not necessarily limited to a distance vision. Low vision applies to all individuals with sight who are unable to read the newspaper at a normal viewing distance, even with the aid of eyeglasses or contact lenses are not possible. People with low vision have to use supportive tools to read and see in their environments. They use a combination of vision and other senses to learn, although they may require adaptations in lighting or the size of print, and learn through the use Braille. Thirdly, the legally blind refer to a vision less than 20 over 200 and a limited range of vision. People who are legally blind cannot see things clearly, whether it is near or far. Totally blind means that the person has no vision at all. Their eyes are not able to process images, and they learn through no visual resources, including Braille.

Finally, colour blindness is also a type of visual problem faced by the visually impaired users. Colour blindness is the reduced ability to perceive certain colours, usually red and green. It is a hereditary defect and affects very few tasks. Contrast sensitivity describes the ability to distinguish one object from another. A person with reduced contrast sensitivity may have problems seeing things in the fog because of the decrease in contrast between the object and the fog. Lastly, visual impairments

can be affecting any of the people at any age. No matter you are old or young you can be affected by these visual impairment problems.

### **2.2.2. Causes of Visual Impairment.**

There are many causes of visual Impairments. The leading causes include macular degeneration, glaucoma, cataracts and diabetes mellitus. Other possible causes include infections, injury, or nutrition [14].

#### **I. Macular Degeneration :**

The progressive deterioration of a critical region of the retina called the macula. The macula is a 3-5 mm area in the retina that is responsible for central vision. This disorder leads to irreversible loss of central vision, although peripheral vision is retained. In the early stages, vision may be gray, hazy, or distorted. Age-related macular degeneration (ARMD) is part of the aging process.

#### **II. Glaucoma:**

A group of eye diseases characterized by damage to the optic nerve usually due to excessively high intraocular pressure (IOP). This increased pressure within the eye, if untreated can lead to optic nerve damage resulting in progressive, permanent vision loss, starting with unnoticeable blind spots at the edges of the field of vision, progressing to tunnel vision, and then to blindness. For example, trauma to the eye could result in the angle becoming blocked, or, as a person ages, the lens becomes larger and may push the iris forward.

#### **III. Cataracts**

Cataracts are cloudiness in the normally transparent crystalline lens of the eye that can cause a decrease in vision and may lead to eventual blindness. Cataracts associated with aging such as senile or age-related