English-to-Malay Speaking Dictionary

(E2MSpeaktionary)

by

Intan Nurhanim Azmi

Dissertation submitted in partial of fulfilling
the requirements for the
Bachelor of Technology (Hons)
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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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Approved by,

_____

(Mr. Jale Ahmad)

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by specified sources or persons.

INTAN NURHANIM AZMI

ABSTRACT

This report is to provide necessary information pertaining to the Final Year Project carried out.

In Chapter 1, we discussed about background, problem statement as well as objective and scope of study/work. This tells basically what the project is all about, the target user, and the areas I attended to throughout the project.

Chapter 2 is brief information about all information, literatures, theories, books, research results, and journals that I reviewed earlier.

In Chapter 3, the methodology used is prototype method and all relevant project works are listed within the chapter.

For Chapter 4, I disclosed my discussions and finding from my research in order to execute the project from time to time while in Chapter 5 is my conclusion and recommendation on the project and relevant matters.

ACKNOWLEDGEMENT

I would like to deliver my greatest appreciation to my supervisor, Mr. Jale Ahmad who has been outstandingly sporting, supportive, understanding, and helpful to me and who let me carry it out my way.

I would also wish to thank Ms. Norhusniah for giving me a lot of information on how to carry out the project based on her experience working with similar project.

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Also to each and everyone who has been involved in this project direct or indirectly, thank you very much. I really appreciate all your kindness and help.
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ABBREVIATION AND NOMENCLATURES

1.	Phonemes	: the smallest sound units of which words are composed
2.	Syllable	: chunk of words based on certain rules
3.	STT	: Speech-to-Text
4.	TTS	: Text-to-Speech
5.	E2MSpeaktionary	: English-to-Malay Speaking Dictionary
6.	V	: Vocal alphabets (a, e, i, o, u)
7.	C	: Consonant alphabets (b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z)

CHAPTER 1
INTRODUCTION

In our daily life, communication is one of the most important ingredients in which, without it we can go crazy. The main thing about communication is the language used. There are many languages in the world. From North to South, from East to West, each speaks different languages.

Though there are countries in the world which use about the same language, but the words, pronunciation, vocabulary, and meaning, could be of different interpretation across the countries. Luckily, we have a language that is widely spoken all over the 196 countries in the world; the English language, which we usually refer to as the language of the world.

Some people have no worries of the language barrier because of not having the needs for it, but some really do bother about this. Often, people who are going out of their own place will need to face the risk of being unable to speak unless if they have the ability of speaking in English. Well verse or not is a different story, but as long as they know English, things will turn out much better as compared to those of English illiteracy.

1.1 Background of Study

In Malaysia, the mother-tongue of the nation is Malay language (Bahasa Malaysia). Having tens of races in the country is not a big deal since almost each and every Malaysian knows the language and communicates freely among each other with Malay language as the mean. Therefore, the needs of English being spoken across the different races are lower as compared to the other countries where people speak their own mother-tongue. Therefore, not every Malaysian knows English very well and they prefer to talk in Malay language. This will create problems to non-Malaysian especially to those who really knows nothing about it.

Nowadays, people travel a lot. Be it for vacation, business, studies, or any other reason, when they come to Malaysia, they need to know our language. It is still fine if they are just dropping by to say "Hello Malaysia", but if they are staying for more than a couple of days, then the need of learning the nation language is there especially for those who plans to stay even longer such as those people who work or study here. People from countries such as England, Japan, America, Australia, India, Arab, Sudan, Vietnam and other countries who knows English but speak other than Malay language will face a great communication problems when trying to interact with Malaysian.

These people have one thing in common; they know English but do not know how to translate it to Malay. Thus, there is a need for an application to help them get to know our language in order to help them better communicate with us. Malaysian especially the Malay people are very particular about Malay language being the main communication medium and therefore, it is a good effort to try help these two parties to have a mean of interaction by allowing non-Malaysian to learn Malay language easily. Not only they will get to know the words, but they could learn and practice on how to pronounce those words as well. It is believed that the project will help to remove or at least reduce the barrier of communication between these two parties.

1.2 Problem Statement

The major problem, as said earlier, is non-Malaysian cannot speak Malay and become unable to communicate with the people of Malaysia. A simple example on the situation is as what happens in the university itself.

In UTP (Universiti Teknologi Petronas, UTP), we have students from different countries who speak different languages. We have Malaysian who speaks Malay, though Malaysian Chinese and Indian may use their own languages as well. We also have International students who came all the way from as near as Thailand, Singapore, and Indonesia, to as far as Vietnam, Cambodia, Myanmar, Iran, Sudan, Turkmenistan, South Africa, Nigeria, and Pakistan to name a few.

When they first arrive, the language is what disturbed them the most. Being friends with them since my first year of study in UTP, I realized that most of them and the local students as well, know English but cannot communicate fluently due to different in slang, pronunciation, vocabulary, and so on so forth.

The International students are even required to take Bahasa Kebangsaan as a subject in their first year of studies, but I believe they does not get much from the class because they only learn a small number of words and most of them forget the words when they enter a new semester. Thus, providing them with Malay language class is not enough to let them learn the language.

1.3 Objectives and Scope of Study/Work

1.3.1 Objectives

1. To accept input keyed into the input box. Alternatively, the system will perform basic speech capturing and recognition and turn the voice into an English word as input for later stage.

2. To perform the function of a dictionary, that is to find the meaning of the input in Malay language by searching from the system database.

3. To display the English word together with the meaning, and speak it out to the user in a way closest to the real way of pronouncing the word by real human.

4. To display the exact way of how the machine could pronounce the word and enabling the user to let the machine say the word again and again, so the user will be able to follow and practice.

5. To include a number of important conversation, such as "Good morning", "How are you?", "Thank you", and "Goodbye" to spark conversation between user and the people around.

1.3.2 Scope of Study/Work

In this project, the first thing is to know and understand the target group which is the non-Malay speaking people. This is done by recalling previous experiences when communicating with the target group, as well as observing people around the campus and outside the campus.

The next issue is to look for possible solutions to their problem and come out with a solution that can cater most of them. In this case, the most common solution is by using a dictionary whether it is a dictionary of variety of languages translated into Malay, or simply an English-to-Malay dictionary. However, the dictionary only let the user know the spelling and meaning of the words without knowing how to say them.

Next, it is necessary to do some research based on previous findings that will enable the development and production of suitable tool as the outcome of the project later on. Right at this moment, the project has already completed and tested with a number of randomly selected users.

Taking into consideration the human preference of listening rather than reading a word on the screen, together with the need to translate from English to Malay, and the greater need of knowing how to pronounce the Malay word as my focus on the project, I came out with an idea to provide a talking dictionary which I called the English-to-Malay Speaking Dictionary or E2MSpeaktionary.

CHAPTER 2
LITERATURE REVIEW AND/OR THEORY

2.1. What is TTS and its area of application

TTS is an acronym which stands for Text-to-Speech; a process of speech synthesis that converts normal text into audible speech. A conceptual definition from *WIKIPEDIA* says that the TTS is "Speech synthesis is the artificial production of human speech.

A system used for this purpose is termed a speech synthesizer, and can be implemented in software or hardware. Speech synthesis systems are often called text-to-speech (TTS) systems in reference to their ability to convert text into speech. However, there exist systems that can only render symbolic linguistic representations like phonetic transcriptions into speech."

A scholar defined TTS as the automatic production of speech, through a grapheme-to-phoneme transcription of the sentences to utter. The TTS synthesizer was said to be a computer-based system that should be able to read any text aloud, whether it was directly introduced to the computer by and operator or scanned and submitted to an OCR (Optical Character Recognition) system (Thierry Dutoit, 1996).

The *Voicemail,Inc.*, in its website, mentioned that the Text-to-speech technology allows an alternate spoken method for conveying textual information. As the

name implies, text-to-speech converts ASCII text into the spoken word. Instead of a digitized recording, however, a synthesized voice is used in order to speak-out words and phrases on-the-fly.

A simpler yet easy to understand theory on TTS or speech synthesis was given by the *Linguatec*. It says that speech synthesis is the artificial reproduction of natural speech. Spoken texts are generated by a computer. Rather than being played from a previously recorded body of texts, each sentence is individually generated.

Putting all the definitions together, it is concluded that the TTS is a system that read any text, extract useful information from it and use it to compose as naturally sounding speech as possible (Y.A. El-Imam and Z.M. Don, 2000).

There are numerous applications and areas where the TTS is used in. Basically, it is used when an application has no text to display or only has small amount of text display available. Example of the areas is text messages, on the phone or in dialog systems, eye-occupancy situations such as operating a motor vehicle, and especially for the blind that, for example, can get the system read a newspaper for them.

2.2. TTS approaches

The TTS systems can be applied using many approaches and the two common approaches are concept-to-speech synthesis and text-to-speech synthesis.

2.2.1. Concept-to-speech

From semantic, pragmatic and discourse knowledge, the Concept-to-speech synthesis approach generates a textual expression which will be used to generate speech signal. This approach is usually applied in systems that involve dialog or user speech.

2.2.2. Text-to-speech

In contrast to the earlier approach, the input to text-to-speech synthesis approach is not generated by the system but will be provided by the user before being analyzed and interpreted so as to deliver a proper pronunciation and emphasis; such as to produce a question instead of a statement.

2.3. Steps in TTS Speech Synthesis

There are several steps or phases taking place in the text-to-speech (TTS) speech synthesis. First of all, the TTS system obtains input from user in the form of text, analyzes the input, and transforms the analyzed input into a description in the form of phonetic. Next, the system will generate the prosody of the phonetic description and combine it with the previously analyzed input to produce a speech signal.

A brief explanation on steps undergone by each and every of the above mentioned processes is as below:

2.3.1. Text analyses

This is the first fundamental step in TTS synthesis. It consists of several steps:

2.3.1.1. Tokenization (Input Segmentation)

Tokenization is also called token-to-word conversion. The token is obtained by segmenting the input text which will then be used to create the orthographic form of the token. For instance, the token "Feb" will become "February" in its orthographic form, formed by token expansion. Similarly, the token "2006" reads "two thousand and six" in its orthographic form.

However, the token expansion is usually hard to obtain especially with a token that is very ambiguous where its expansion depends on what it denotes.

2.3.1.2. Token Analyses

Another concern in text analyses is the context of the token. In TTS synthesis, the context is also analyzed. For example, an abbreviation "tgl" in Germany can be expanded into many words.

Without the context analysis, one may or does not know which word should it be expanded into; is it "täglich", "tägliche", "täglichem", "täglichen", "täglicher" or "tägliches". Also, the German language requires the use of context analysis in clarifying stress patterns which cannot be differentiated from their spelling.

2.3.2. Pronunciation rules

In a speech synthesis program, letters and phonemes correspondence is sometimes parallel and some other times serial. It is clear that letters cannot be transformed 1:1 into phonemes. So, pronunciation rules will need to be applied once the text analysis is completed.

If in some environment, a single letter can correspond to several phonemes at a time, such as the "x" in "**x**ylophone", some single letter may correspond to no phoneme at all, such as the letter "h" in "mo**h**d").

Similarly, there are cases where several letters can correspond to just one single phoneme, just like the case of "ck" in "si**ck**"), and other cases where one phoneme can correspond to more than one set of different letters as what is seen in the case of "bad" and "bed".

Not to mention, there are letters that is pronounced differently in different environments, for example "g" "gig" and "g" in "Gillette". Two strategies can be used to determine pronunciation:

2.3.2.1. Dictionary-based

Using dictionary-based strategy with morphological components to determine pronunciation solutions will require the system to have as many morphemes or words as possible to be stored in its dictionary.

Inflection, derivation, and composition rules are the means used to generate the full forms of dictionary that is used in which all possible forms of word are stored. Pronunciation of words that is not found in the dictionary will be based on these pronunciation rules.

2.3.2.2. Rule-based

The rule-based solution suggested that a TTS system generates pronunciation rules from the phonological knowledge of dictionaries available in the system. Thus, the dictionary only includes words whose pronunciation is a complete exception.

A significant difference between the two listed approaches is the size of their dictionaries; that of the dictionary-based solution is plenty of times larger than the dictionary of exceptions that belongs to the rule-based solution.

With that big of dictionary plus if they have a large enough phonetic dictionary available, dictionary-based solutions is more exact in producing pronunciation than rule-based solutions.

2.3.3. Prosody generation

The prosody is generated once the pronunciation is determined. A TTS system's degree of naturalness is reliant on prosodic factors such as

2.3.3.1.1. Intonation modeling: phrasing and accentuation

2.3.3.1.2. Amplitude modeling

2.3.3.1.3. Duration modeling: duration of the sound and pauses determine the length of the syllables and the tempo of the speech.

Prosodic characteristics carry a range of functions:

- They are able to make the focus of a sentence clear, i.e. a phrase is emphasized as being important or new.
- They are responsible in sentence segmentation by creating connections between sentences or parts of sentences and determine its mode whether it is a statement or a question.

Syntactic information is highly essential and important in generating prosody. The prosody can be calculated by means of knowledge of a sentence's syntactic structure for most sentences.

On the other hand, semantic and pragmatic information is important in some other sentences. This is especially for sentences with ambiguous syntactic structure. This kind of sentences often acquires a new meaning, depends on which component is emphasized.

In negative sentences, focus marking is especially vital: the emphasis should be made to highlight components that are referred to by the negation.

However, the semantic and pragmatic knowledge is available in few TTS systems.

2.3.4. Signal processing

Data from speech processing module is delivered to the signal processing module to perform audio signal synthesis.

The selection and linking of speech segments takes place in concatenate synthesis while for individual sounds, if several appropriate options are available, the best options are queried and selected from a database and concatenated.

CHAPTER 3
METHODOLOGY/ PROJECT WORK

3.1 Methodology

The prototype methodology is able to reduce the amount of time required throughout the whole project until a working prototype is derived, produced, and presented to the target group or user. The prototype model is as follows:

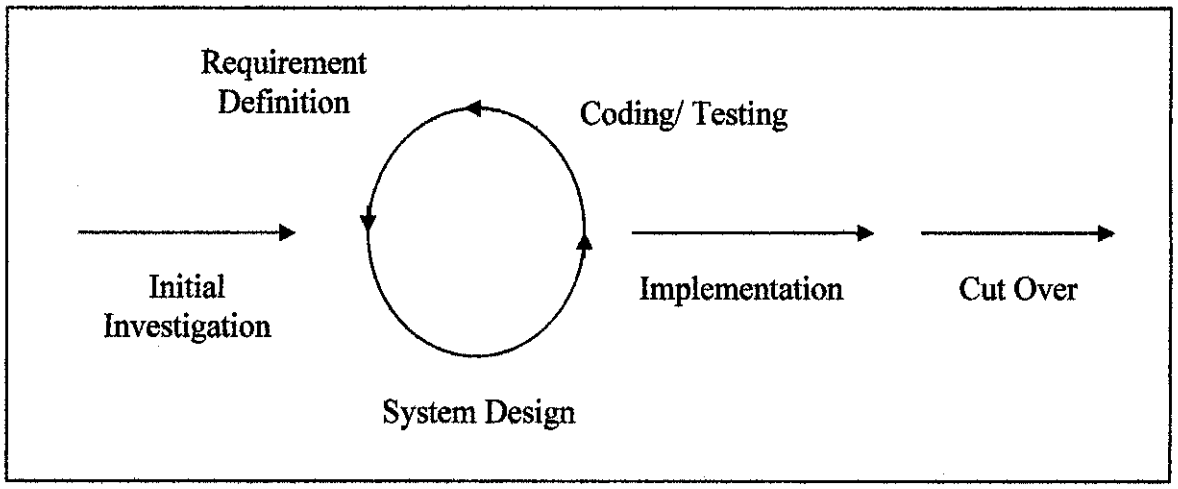

Figure 1 : Prototype model

3.1.1 Initial Investigation

In initial investigation, some important matters were being addressed; which are project title clarification and understanding, analyses of area of study and project.

Prior to the topic, this project is aimed to design a speaking dictionary to convert an English word into Malay word and speak it out as naturally Malay as possible.

3.1.2 Requirement Definition

This is the stage where methods and approaches are determined. Among them were the determination of tools and equipment required, knowing and understanding the target group and coming out with suitable requirement that can meet the objectives of the project.

3.1.3 System Design

This is the part where the system or tool is attended to in practical. How the system is going to work, what are the functions it can provide, and all related matters will be addressed in this phase as to get ready with all necessary information and preparation. Some existing programs and products have been tested as comparison and to get the feel of how a TTS looks like.

3.1.4 Coding/ Testing

After all, this is the real technical part of the system where the programming is taking place. Microsoft SDK is necessary as the development tool for this system since it has incorporated important tools of speech recognition in it. A system voice is required to speak the result

out to the user. Throughout this phase, testing were carried out so as to see, measure and detect what needs correction, improvement and so on so forth, until it is completed.

3.1.5 Implementation

After the coding and testing phase is done, the system will be ready for deployment. This is where the field testing will be done by a number of user. Once it is over, the system will be installed and implemented in user's site for deployment.

3.1.6 Cut Over

Also understood as the maintenance stage, the cut over phase is the time for maintenance. Since it is going to be a new experience for everyone, I will need to keep close eyes on the system and maintain it from time to time as to ensure everyone is happy with it and it can function without much hassle.

3.2 Procedures

3.2.1 Discussion with supervisor

I have had a long discussion with my supervisor to come out with the idea and generate clearer understanding on what are the things possible to be done with this topic as well as what is there for me to look for in order to contribute to the people through my works later on.

3.2.2 Research

Gaining some ideas from previous discussion, I went deep into the sea of information available in the Internet. My research goes from as simple as to know and understand the situation and problems faced by the target group, into as complex as how to enable the system voice to speak the Malay word as natural as possible. My approach prior to researching on the issue was to study the way a system voice speaks when it is given a word via trial-and-error using a prototyped which have been developed earlier, until a suitable way is found and applied into the system.

3.2.3 Discussion with friends

Lucky for me to have a friend who has done a project on this speech recognition before, he was willing to brief me on what to do along the path, what tools I need, who can I refer to and so on so forth, which gave me a key to open the door to more ideas. Even better, my friends were all willing to give ideas on what they prefer to have if they were to be the user of the system, which let me know user interest so I could try to meet them in my project.

3.3 Tools Required

3.3.1 A text-inputting device i.e. Keyboard

3.3.2 A storage device i.e. Hard disk, thumb drive, or memory card

3.3.3 An operating device i.e. Computer or PDA

3.3.4 A display device i.e. Monitor or screen

3.3.5 A development tool i.e. Microsoft SDK

3.3.6 A database i.e. Oracle 9i for system-defined words, text files for extra words

3.3.7 A sound producing device i.e. speaker or headphone

3.4 System architecture and processes

3.4.1 The Input

First thing first will be the input. The main method of inserting word will be text keyed in by user, just like in common systems that accept words keyed in using keyboard or similar text-inputting devices.

The system only takes and accepts one single word as input except pre-defined simple sentence that is already been put in the dictionary (database). Any input other than text or that are not in the database will be automatically ignored.

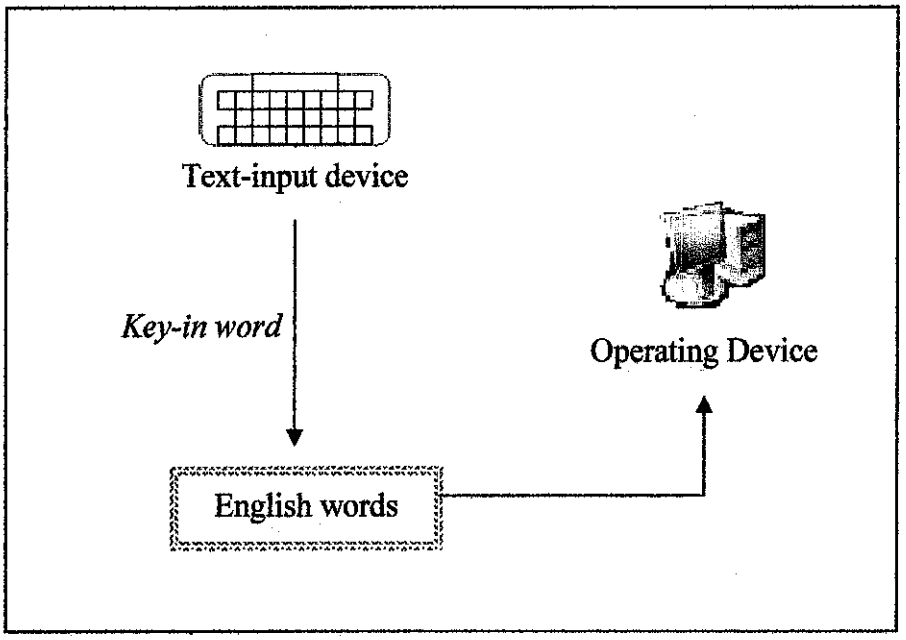

Figure 2: System input architecture

3.4.2 The Dictionary

When we have the input, the system will perform the function of a dictionary. This is done by searching the system database for the exact word as the input, and gets the meaning in Malay. Both input word and corresponding Malay word will be displayed to the user.

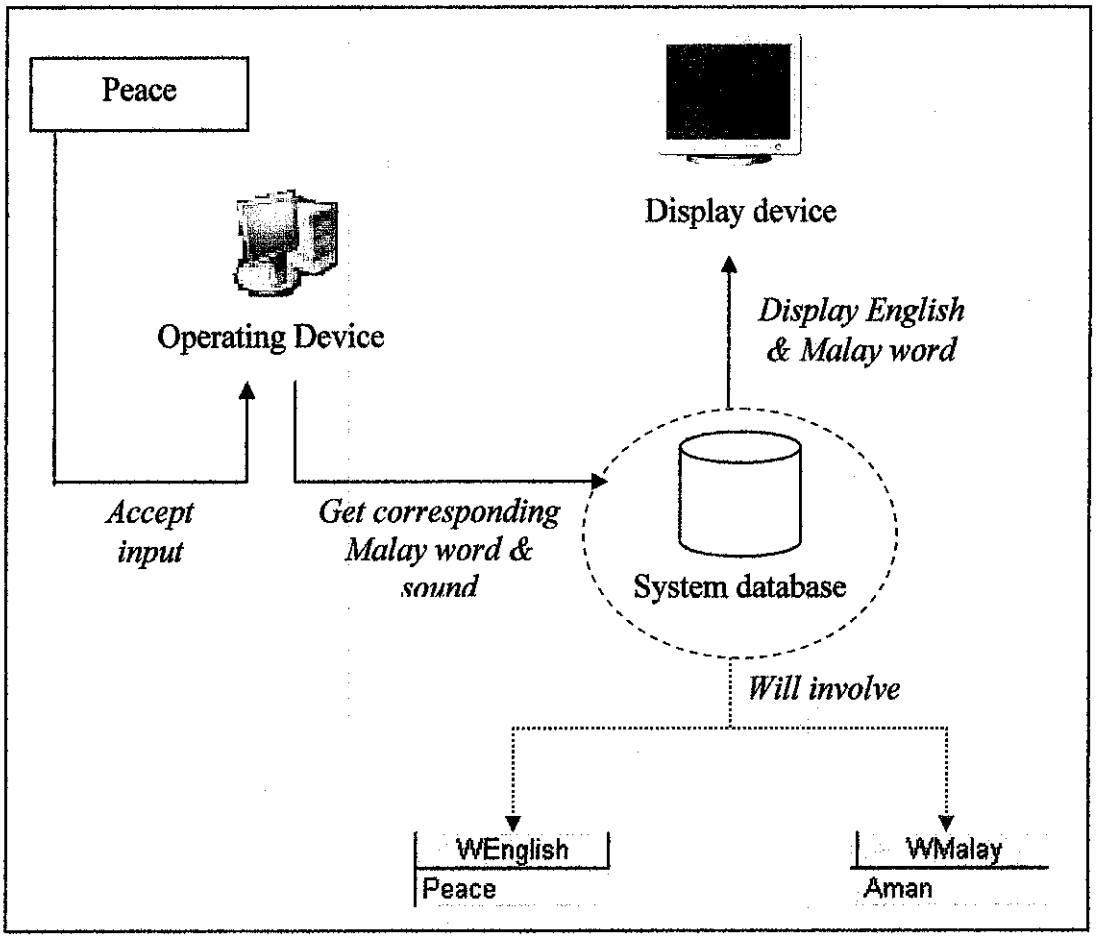

Figure 3: System dictionary architecture

3.4.3 The Speaking Dictionary

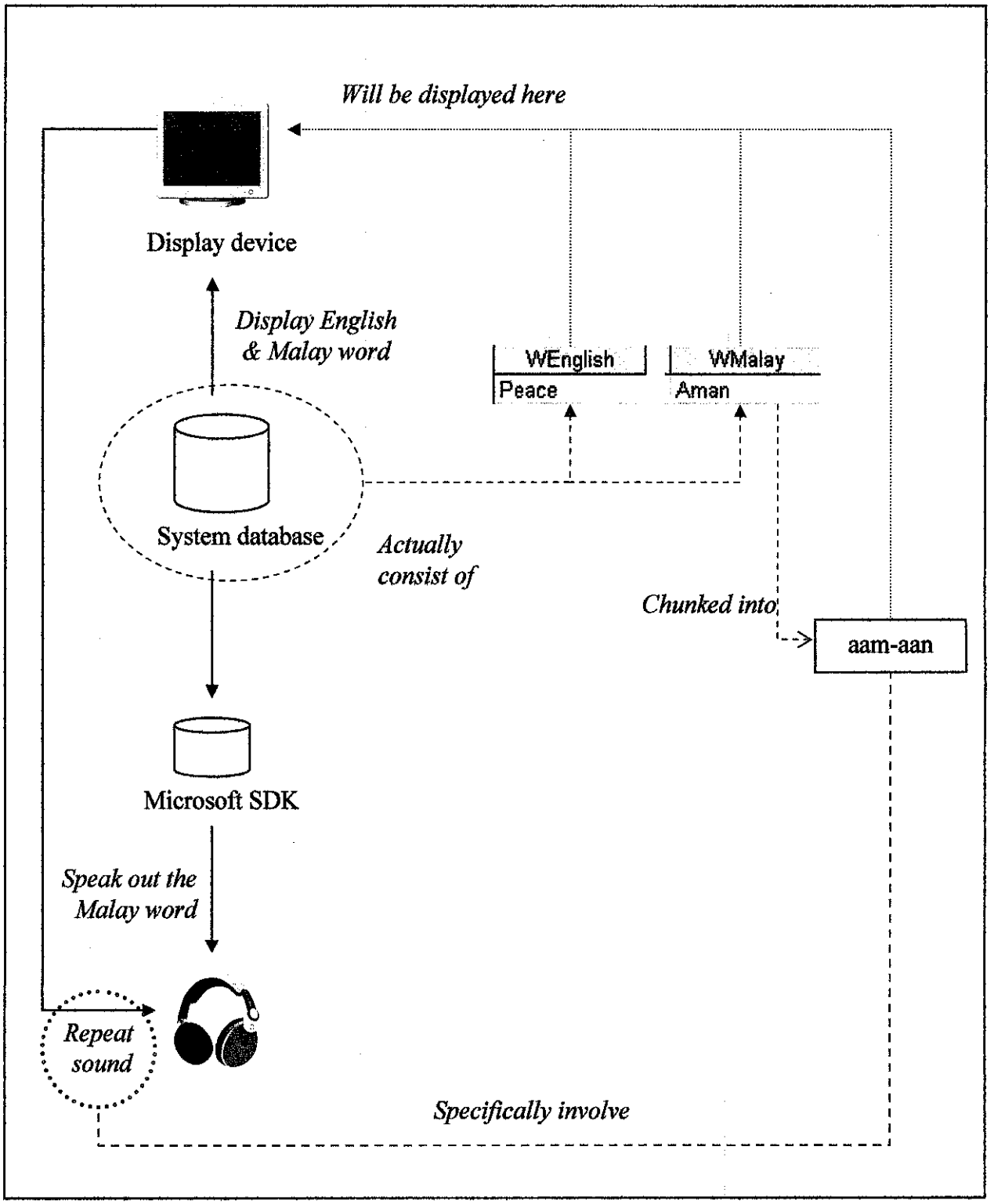

Figure 4: System speaking dictionary architecture

The sound of the acquired result has actually been studied earlier using a pre-developed prototype. The findings from the studies were put in the coding as selection for the program to execute and call once a chunk met a selection. The selected sound will be spoken to the user.

If a user wish to repeat the spoken word, a function named "Speak" is available. This is the focus of my project, which is to enable the system voice to speak a Malay word as naturally as possible, so the user can learn and practice in easier way.

3.4.4. Full system architecture

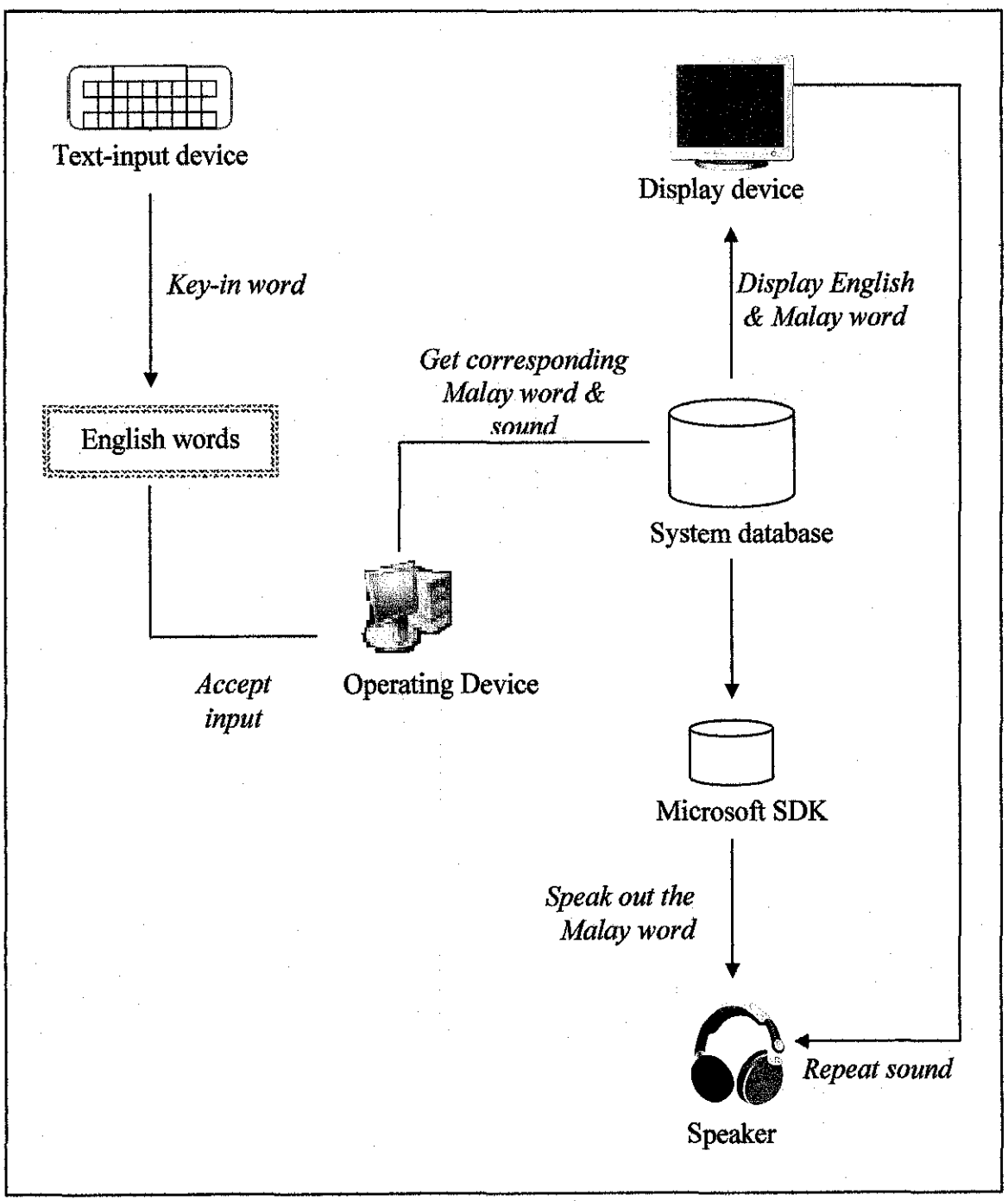

Figure 5: E2MSpeaktionary full system architecture

3.4.5 Word chunking (syllabification) technique

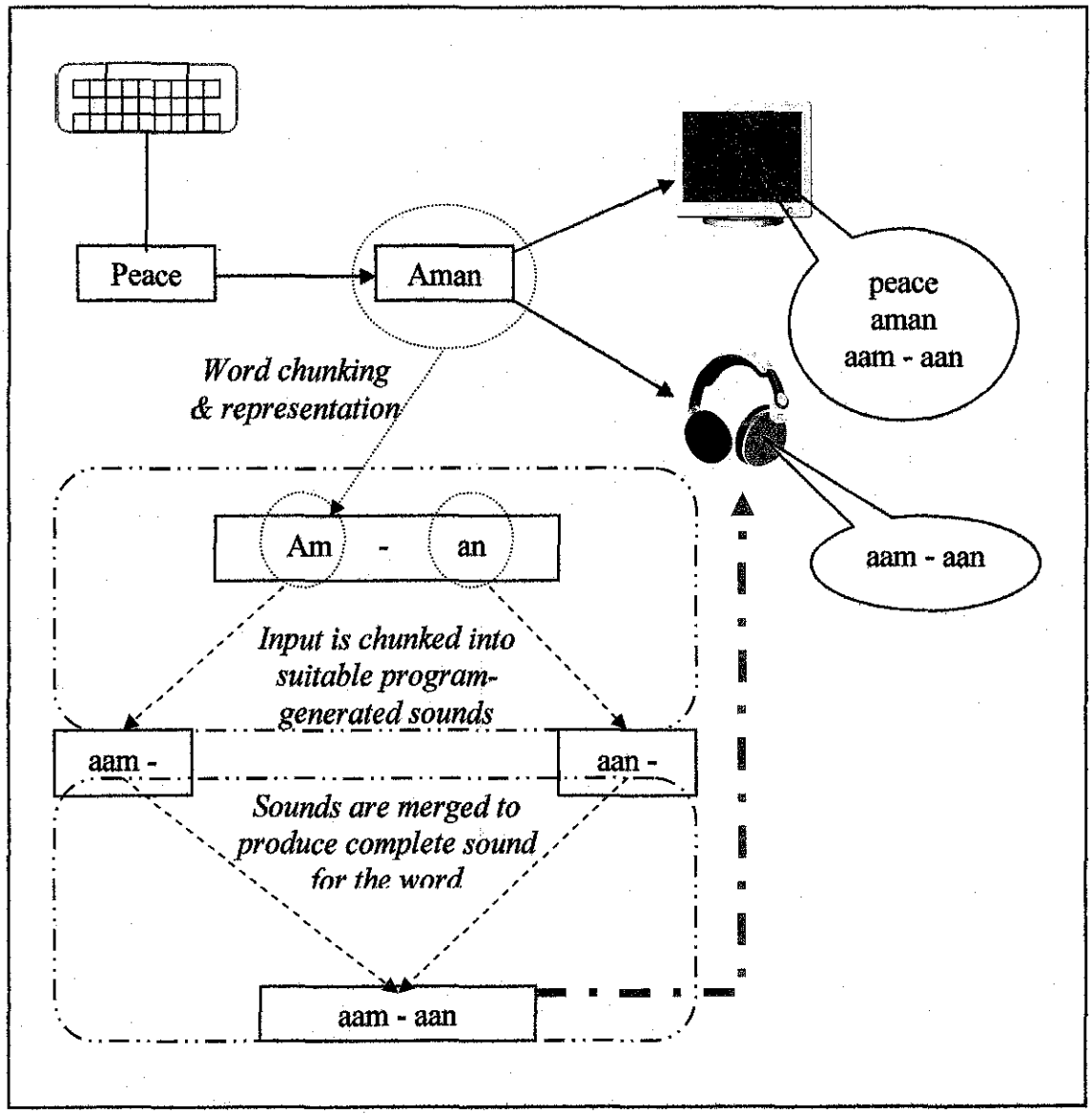

Figure 6: Technique of chunking Malay words to produce more natural way of pronouncing the word by system voice

The above figure is a representation of the system in a way that is simple and easy to understand. This is used for all words available in the database.

In TTS, the chunking process is known as syllabification where the system will break the vocal (V) and consonant (C) of the word into syllables.

1. The picture of keyboard symbolizes the process of entering input "Peace" into the system.

2. "Peace" means "Aman" in Malay language, obtained from the database.

3. The word "aam-aan" will be chunked into suitable combinations of Vocal (V) and Consonant (C) to correctly represent the sound of the chunk as what is spoken by the Malaysian.

    a. In the example, 'am' and 'an' was separated when we have VC meeting VC. In this case we have 'am' meeting 'an'. The system voice needs 'aa' to produce a sound similar to 'a' in Malay, so we replace the 'am' with 'aam' and 'an' with 'aan'.

    b. Similarly, the sound of 'e' as in *'ekor'* requires the spelling of the output to be changed from just 'e' to 'eh' before the system voice can speak it in the Malay way. Here, the program is limited to only say 'e' as in *'ekor'* only, not as in *'enam'* as well.

    c. Contradict with the case of 'a' which is changed to 'aa', putting 'ee' does not resolve the sound of 'e'. In fact, it solves for pronouncing 'i' in Malay words.

d. The case of Malay-way of pronouncing 'o' is not very much similar to 'e' where the 'o' will be changed to 'oh' to make sure the 'o' in the obtained Malay word will be said just as it is supposed to be.

4. The sound of "Aman", which is "aam-aan" will be spoken out by the system voice and can be heard using a sound producing device such as the headphone as represented in the figure.

5. All the three words, "Peace", "Aman", and "aam-aan" are displayed on the display device, as what we can see on the monitor. The purpose of displaying the chunked word, as mentioned earlier, is to let the user practice in their mouth opening so they can try and say the word as correctly as it should be.

CHAPTER 4
RESULTS AND DISCUSSION

The TTS fundamentals, approaches and structures are highly essential in completing the project. In the Literature Review, the TTS was said to have either concept-to-speech or text-to-speech and a developer will need to choose between dictionary-based or rule-based pronunciation.

As for the E2MSpeaktionary, the text-to-speech approach with dictionary-based pronunciation were chosen and applied. However, the way of tokenizing the input and generating the prosody for the program were a bit different from what was suggested earlier in the report.

Using a prototype, the sounds were tested and recorded from time to time to see which combination of vocal and consonants meet which syllable of speech that is similar to the Malay way of pronouncing words. In the project, the process of producing tokens from words was termed *"chunk"* for easier understanding while the commercial term for it is syllabification.

The dictionary-based pronunciation applied in the project is hard-coded in the program and was not placed in the database; therefore the dictionary is actually contained in the program itself. The process of translating the input from English to Malay word involves a database which consist a list of English words together with the meaning for each word.

The dictionary caters most commonly used syllables or chunks in Malay words including sets of Vocal (V) and Consonant (C) such that it meets these cases:

- Vocal, Consonant (VC)
- Vocal, Consonant, Consonant (VCC)
- Consonant, Vocal, Consonant (CVC)
- Consonant, Vocal, Consonant, Consonant.(CVCC)

The program is limited to process only one word at a time except for pre-defined simple sentences, and does not filter type of input as well as gives no respond if undesired input is inserted.

		Vocal				
		Vocal 'a'	Vocal 'a'	Vocal 'a'	Vocal 'a'	Vocal 'a'
First character from group of vocal	'a'	aah-aah-	aah-eeh-	aah-ooh-	aah-eh-	aah-oh-
	'e'	eh-aah-	eh-eeh-	eh-ooh-	eh-eh-	eh-oh-
	'i'	ee-aah-	eeh-eeh-	ee-ooh-	ee-eh-	ee-oh-
	'o'	oh-aah-	oh-eeh-	oh-ooh-	oh-eh-	oh-oh-
	'u'	ooh-ah-	ooee-	ooh-ooh-	oo-eh-	oo-oh-

Table 1: Example of chunks (syllables) of Vocals (a, e, i, o, u)

		Vocal				
		Vocal 'a'	Vocal 'i'	Vocal 'u'	Vocal 'e'	Vocal 'o'
First character from group of consonant	Its own	aah-	eeh-	ooh-	eh-	oh-
	'b'	bah-	beeh-	booh-	beh-	boh-
	'c'	chaah-	cheeh-	chooh-	cheh-	choh-
	'd'	daah-	deeh-	dooh-	dae-	doh-
	'f'	faah-	feeh-	fooh-	fe-	foh-
	'g'	ghaah-	gheeh-	ghooh-	gheh-	ghoh-
	'h'	haah-	heeh-	hooh-	heh-	hoh-
	'j'	jhaah-	jheeh-	jhooh-	jheh-	jhoh-
	'k'	kah-	kee-	koo-	keh-	koh-
	'l'	laah-	leeh-	looh-	leh-	loh-
	'm'	maah-	meeh-	mooh-	mae-	moh-
	'n'	naah-	neeh-	nooh-	nae-	noh-
	'p'	pah-	peeh-	pooh-	peh-	poh-
	'q'	qah-	qea-	qoo-	qeh-	qoh-
	'r'	rah-	reeh-	roo-	reh-	roh-
	's'	sah-	see-	soo-	saih-	soh-
	't'	ta-	tea-	too-	tae-	toh-
	'v'	vah-	vee-	voo-	vaih-	vo-
	'w'	wah-	wee-	woo-	waih-	wo-
	'x'	xah-	xee-	xoo-	xaih-	xo-
	'y'	yah-	yee-	yoo-	yeh-	yo-
	'z'	zah-	zee-	zoo-	zeh-	zo-

Table 2: Example of chunks (syllables) of Consonant, Vocal (CV) of all Consonants (b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z)

		Vocal and consonant				
		'ab'	'ib'	'ub'	'eb'	'ob'
First character from group of consonant	Its own	aahb-	eehb-	oohb-	ehb-	ohb-
	'b'	bahb-	beehb-	boohb-	behb-	bohb-
	'c'	chaahb-	cheehb-	choohb-	chehb-	chohb-
	'd'	daahb-	deehb-	doohb-	daeb-	dohb-
	'f'	fab-	feehb-	foohb-	fehb-	fohb-
	'g'	ghaahb-	gheehb-	ghoohb-	ghehb-	ghohb-
	'h'	haahb-	heehb-	hoohb-	hehb-	hohb-
	'j'	jhaahb-	jheehb-	jhoohb-	jhehb-	jhohb-
	'k'	kahb-	keeb-	koob-	kehb-	kohb-
	'l'	laahb-	leehb-	loohb-	lehb-	lohb-
	'm'	maahb-	meehb-	moohb-	maeb-	mohb-
	'n'	naahb-	neehb-	noohb-	naeb-	nohb-
	'p'	pahb-	peehb-	poohb-	pehb-	pohb-
	'q'	qahb-	qeab-	qoob-	qehb-	qohb-
	'r'	rahb-	reehb-	roob-	rehb-	rohb-
	's'	sahb -	seeb-	soob	sahib	sohb-
	't'	tahb-	teab-	toob-	tab-	tohb-
	'v'	vahb-	veeb-	voob-	vaihb-	vob-
	'w'	wahb-	weeb-	woob-	waihb-	wob-
	'x'	xahb-	xeeb-	xeub-	xaihb-	xob-
	'y'	yahb-	yeeb-	yoob-	yehb-	yob-
	'z'	zahb-	zeeb-	zeub-	zehb-	zob-

Table 3: Example of chunks (syllables) of Consonant, Vocal, Consonant (CVC) of all Consonants (b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z) with ending Consonant excluding c and g

		Vocal and consonant				
		'ab'	'ib'	'ub'	'eb'	'ob'
First character from group of consonant	Its own	Aahch-	Eehch-	Oohch-	Ehch-	Ohch-
	'b'	Bahch-	Beehch-	Boohch-	Behch-	Bohch-
	'c'	Chaahch-	Cheehch-	Choohch-	Chehch-	Chohch-
	'd'	Daahch-	Deehch-	Doohch-	Dehch-	Dohch-
	'f'	faahch-	Feehch-	Foohch-	Fehch-	Fohch-
	'g'	Ghaahch-	Gheehch-	Ghoohch-	Ghehch-	Ghohch-
	'h'	Haahch-	Heehch-	Hoohch-	Hehch-	Hohch-
	'j'	Jhaahch-	Jheehch-	Jhoohch-	Jhehch-	Jhohch-
	'k'	Kahch-	Keech-	kooch-	kehch-	Kohch-
	'l'	Laahch-	Leehch-	Loohch-	Lehch-	Lohch-
	'm'	Maahch-	Meehch-	Moohch-	Mehch-	Mohch-
	'n'	Naahch-	Neehch-	Noohch-	Naech-	Nohch-
	'p'	Pahch-	Peehch-	Poohch-	Pehch-	Pohch-
	'q'	Qahch-	qeach-	qooch-	qehch-	Qohch-
	'r'	Rahch-	reehch-	rooch-	rehch-	Rohch-
	's'	Sahch-	Seehch-	Soohch-	Saihch-	Sohch-
	't'	taahch-	teach-	tooch-	tehch-	Tohch-
	'v'	Vahch-	veech-	vooch-	vaihch-	Vohch-
	'w'	wahch-	weech-	wooch-	waihch-	Wohch-
	'x'	Xahch-	xeech-	xeuch-	xaihch-	Xohch-
	'y'	Yahch-	yeech-	yooch-	yehch-	Yohch-
	'z'	Zahch-	zeehch-	zeuhch-	zehch-	Zohch-

Table 4: Example of chunks (syllables) of Consonant, Vocal, Consonant (CVC) of all Consonants (b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z) with ending Consonant in the case of c and g

CHAPTER 5
CONCLUSION & RECOMMENDATION

The Final Year Project gives me a room to explore new things, obtain new knowledge and gain new experiences. The project is something I have never done before, and therefore I have to put 110 percent effort into it to make sure everything turns out the way it should be.

In my opinion, this is a project with a good market prospect and demand, and it is applicable in almost any similar situation apart from what is mentioned in this report. If this project is to be deployed by any interested parties later on, it is hoped that it will be able to contribute to GNP of the country by having the user of the system keep coming to Malaysia again and again, so as to achieve our aim to increase the number of people who speak the language all over the world and bring it up to another level just like during its good time.

The most challenging part of the project, as mentioned earlier, was the process of determining the techniques to let the system voice speak the Malay word as naturally as possible, just like a Malay native will do. It took me almost hours of man-time doing trial-and-error before the correct method was obtained, and once the correct result came out, it paid off my sweat and threat.

For future enhancement, it is suggested that the dictionary is placed in a database and cater for bigger sets of syllables or chunks. Also, it will be a good idea if the input can be extended into speech input as well, so it can benefit handicap people especially the blind and those of physically handicapped that cannot use a keyboard to insert the input.

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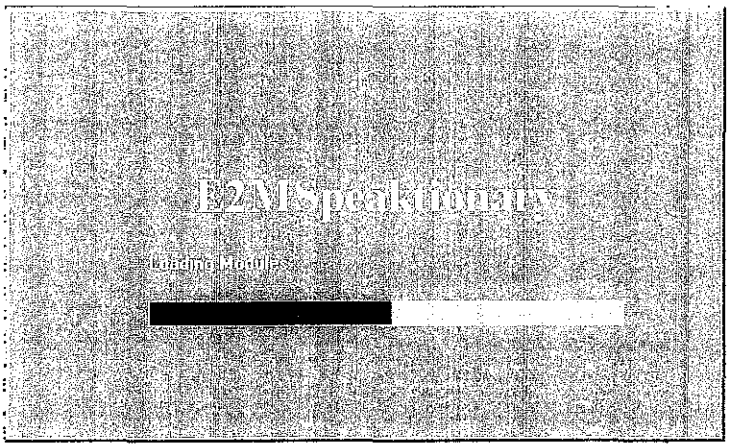
APPENDICES

E2MSpeaktionary SCREEN SNAPSHOTS

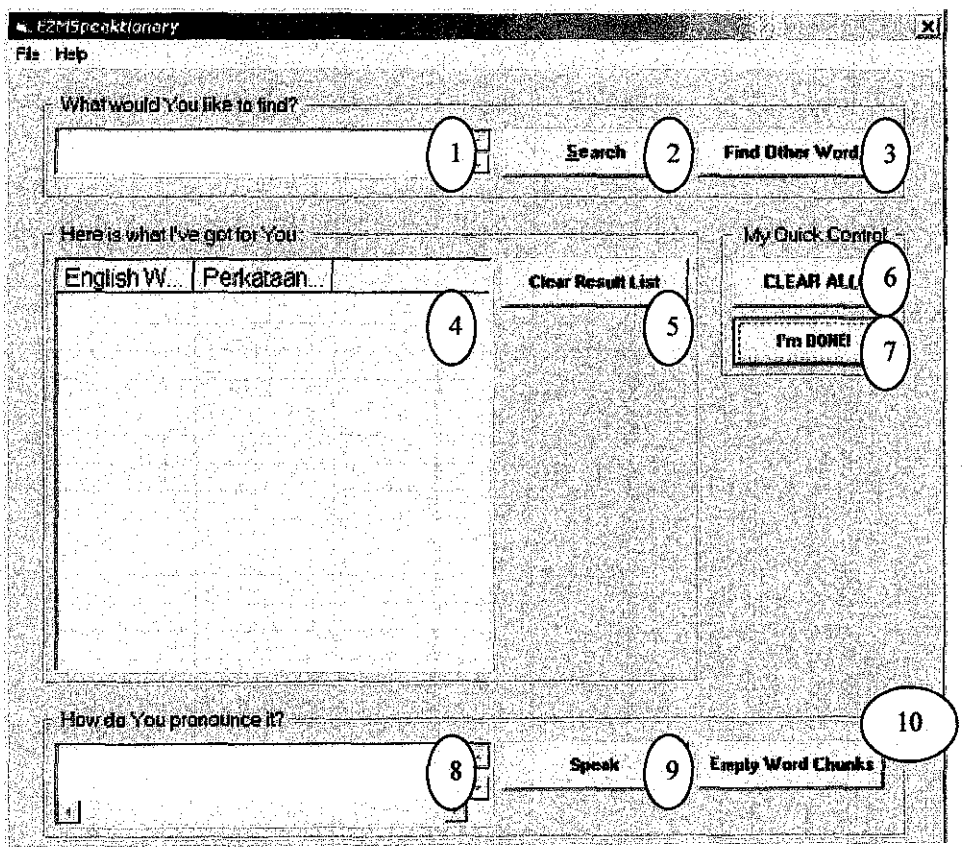
APPENDIX A: Splash Screen

The splash screen will appear immediately once the project is executed.



APPENDIX B : The Main Page

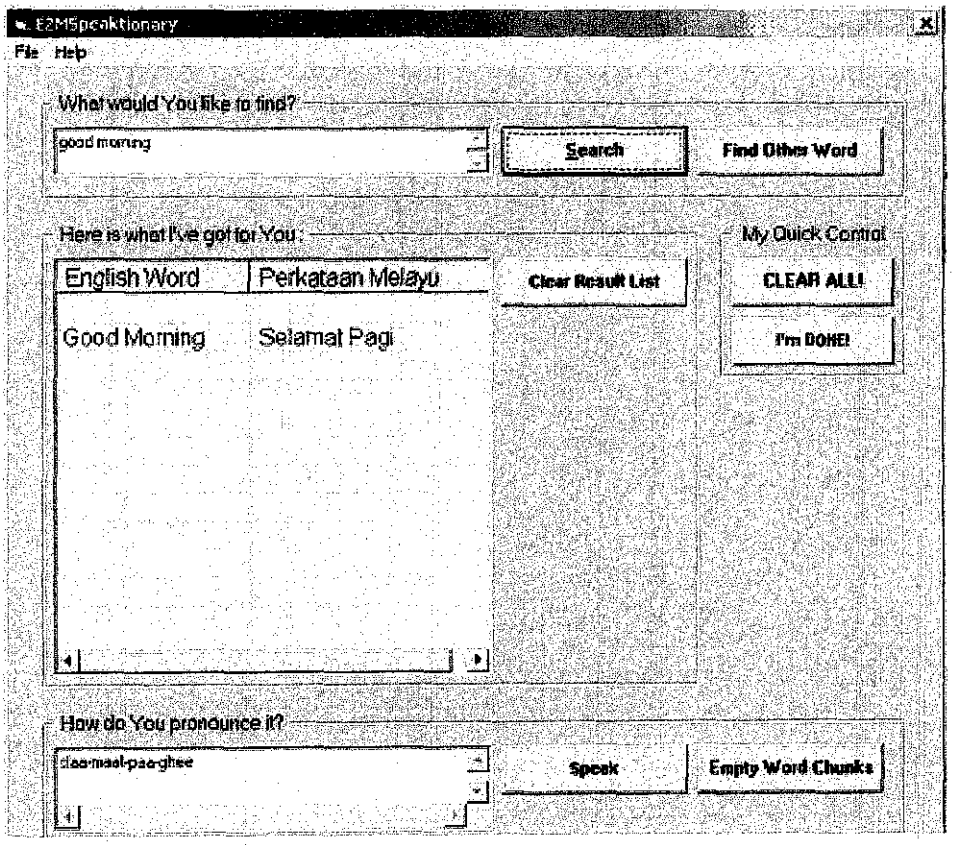
The main page consist all the functions needed to perform by the program as below.



1. Enter word to search
2. Find exact word in dictionary
3. Clear the input text box to enter another word
4. Display result from dictionary
5. Clear dictionary findings from list
6. Clear all text boxes and list of result
7. End program execution
8. Display chunks of Malay word
9. System voice speak resulting Malay word
10. Clear word chunks from text box

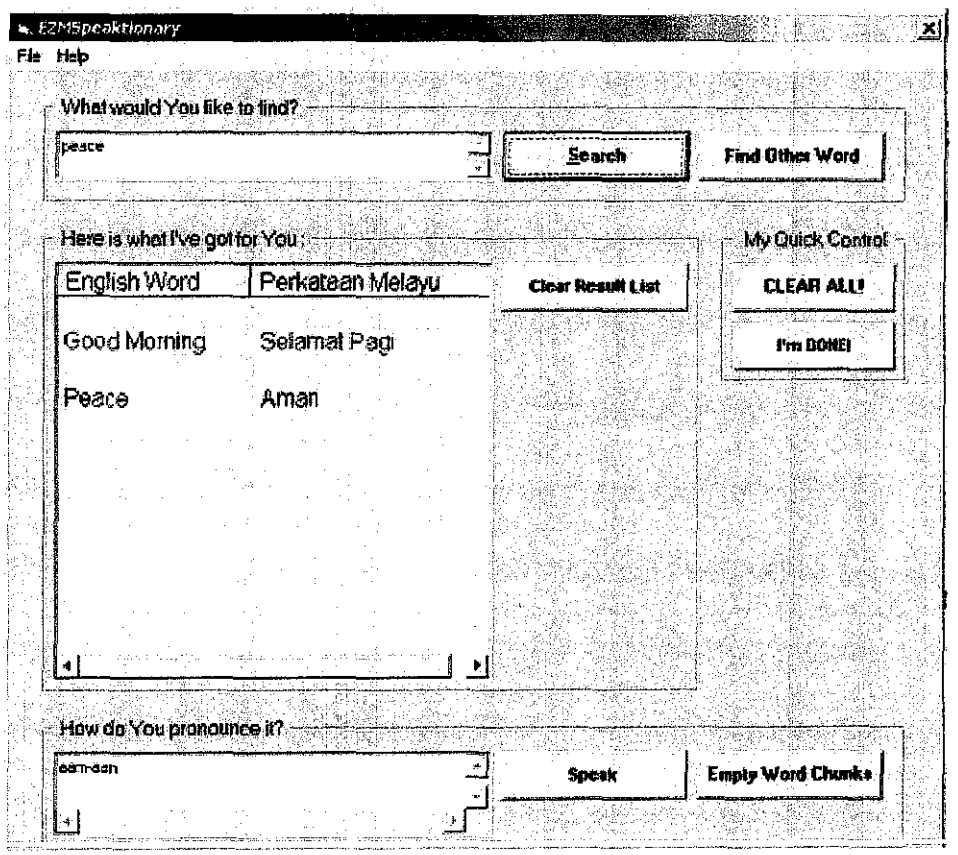
APPENDIX C: Sample input of short conversation – *"Good Morning"*

Let say we enter a short conversation saying "good morning" into the input box and press the button 'Search' to find the corresponding Malay word. Once the searching is completed, the corresponding Malay sentence will be displayed in the result list and the chunks of the Malay words will be displayed in the text box at the bottom of the form.



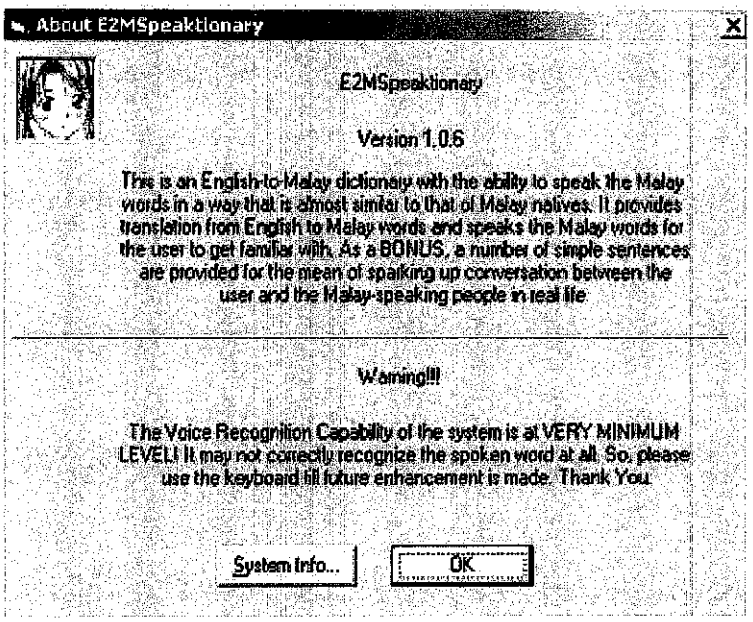
APPENDIX D: Sample input of single word – *"peace"*

The process of finding a single word is just the same as finding a short pre-defined sentence as described in above.



APPENDIX E: About

This form tells briefly about the product, its purpose and capability, and limitation of the current release.



Appendix F: Thank you message

Once a user click on the 'I'm DONE' button, the program will terminate and display a thank you message box to the user. The program will end completely when button 'OK' is pressed.