ARABIC TO MALAY MEDICAL DIALOGUE TRANSLATION SYSTEM BASED ON THE GRAMMATICAL RULES

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ABSTRACT

Machine Translation (MT) is one of our great dreams in computer application. Malay language is becoming essential tool for Arab people especially in Malaysia. To satisfy this need, we develop the techniques for the Arabic Malay dialogue translation system. The problems of this research is different structure of interrogative dialogue sentences, verb conjugated in dialogue sentences, and ordering of adjective and adverb in all types of dialogue sentences. This research focuses on the analysis of morphology and syntax of Arabic and Malay dialogue sentences to produce grammatical rules that can be apply on Rule Based Machine Translation approach to translate Arabic to Malay dialogue. Rule Based Machine Translation approach (RBMT) is based on certain rules to convert source text (Arabic) structure to target text (Malay) structure. It includes a source language sentence, analysis module, transfer module, and generation module. This research contains fifty dialogue sentences (50) in medical domain (dialogue between doctor and patient) have been tested by our system (computer translation algorithm) and the results were compared with human translation. The result shows around 87.2% accuracy of the dialogues translation from Arabic to Malay languages. This study shows 13% incorrect translations due to applying incorrect rules or there is ambiguous of words.

Keywords: Machine translation, Dialogue sentences, Rule based approach, Automatic Translation, Rule Based Machine Translation approach, Transfer Driven Machine Translation, Arabic Malay Dialogue Translation system, part of speech.

1. INTRODUCTION

Machine Translation (MT) has been defined as Automatic Translation (AT) from one language to another [1]. The dialogue translation is not easy task because the dialogue sentences are ungrammatical sentences and depend on context of sentence. In dialogue translation we can define more clearly what information should be translated from source language to target

language [19]. There are still problems in translation of dialogues from one language to another, many researchers tried to solve these problems. For example [10] tried to solve the translation of irregular expressions problem in a dialogue such as, incomplete sentence and ungrammatical sentence from Japanese to English, [9] have solved recognition errors in a speech dialogue to translate English to Japanese ,and [21] solved the ambiguity problem in the dialogue translation from Chinese to English. Also there are other people works on interrogative sentence as a type of dialogue sentence such as. [14] that has developed a bi-lingual Machine Translation (MT) tool in the agriculture domain. The tool follows the transfer-based MT approach and it can be used as stand–alone tool and very well integrated with a general MT system for Arabic sentence. This tool is used to translate the interrogative sentence that is one type of dialogue sentences from Arabic into English, in the fact translation of Arabic interrogative sentence is not easy task. The most difficulty comes from the difference of sentence structure in source and target language, whereas this challenge is the same challenge that we faced in Arabic and Malay dialogue translation. [17] represented the translation of interrogative sentence types from Hindi to English. The problem that has solved in this work is the different ordering of question words in all types of interrogative sentence. At the same time [20] presented a method to develop translation quality of dialogue. This method is Transfer Driven Machine Translation (TDMT) that applies the transfer rules to a source sentence. They proposed using the linguistic information that includes information about syntactic and structure in analysis level in the source sentence. This work focuses on polite expressions translation in a dialogue from English to Japanese for travel arrangement.

2. DIFFERENT STRUCTURE OF DIALOGUE SENTENCES IN ARABIC AND MALAY LANGUAGES

The dialogues are classified into certain categories that are interrogative, statement, exclamation and imperative sentence [15]. Interrogative sentence is used to ask question, a statement type that declares a fact, exclamation shows a surprise or strong event and imperative sentence is used to give an order or command. The following section describes different structure of dialogue sentences.

2.1 Interrogative Sentence

The interrogative sentence is the main sentence in a dialogue [16]. Basically, the interrogative sentence in Arabic has the same structure in Malay that is question word is the first of the sentence then can be noun phrase or verb phrase. But the question word in Malay can be come in the end of the interrogative sentence in some cases. Table1 shows question words in Arabic and Malay. Some examples of using question words in the interrogative sentences are described in table 2.

TABLE1 QUESTION WORDS IN ARABIC ANDMALAY

أدوات الاستفهام	Kata Tanya	English translation
ماذا	Apakah	What
متى	Bila	When
أين	Where	Mana
لماذا	Mengapa	Why
من	Siapa	Who
هل	Adakah	Do/does/Is
كيف	Bagaimana	How
كم	Berapa	How much
ما	Apa	What
اي	Yang mana	Which

TABLE 2 STRUCTURE OF INTERROGATIVE SENTENCE IN A DIALOGUE

Arabic sentence	Arabic structure	Malay sentence	Malay structure
ما لسمك؟	QW N Pro	Apakah nama anda?	QW N PRO
هل اكلت اكل من الخارج؟	QW V PRO N PREP N	Adakah anda makan makanan dari luar?	QW PRO V N1 PREP N2
اي يوم اليوم؟	QWN ADV	Hari ini hari apa?	ADV N QW

2.2 Statement Type

This type has several different structures in Arabic and Malay. First we will show the general structure of dialogue sentence in Arabic and Malay and differences between them. Then we will focus on the structures which have the problems that we faced in our research are described as following:

2.2.1 Verb Subject Order

In general, the default word ordering in Arabic is verb (V) followed by subject(S) then object (O)[13]. On the other hand, the word order of Malay is subject (S) verb (V) O (object) [8]. Examples are shown in the following table.

TABLE 3 EXAMPLES OF VERB-SUBJECTORDER IN A DIALOGUE SENTENCE

Arabic sentence	Arabic structure	Malay sentence	Malay structures
أنت تحتاج راحة في المنزل	S V O	Anda perlu berehat di rumah	S V O
أعاني من صداع شديد	V S O	Saya menderita sakit kepala kuat	S V O

2.2.2 Verb Conjugated

The subject is dropped in some cases in Arabic and appears as a verb conjugated, which related to a verb as prefix or suffix. This case occurs in a dialogue sentence more than normal sentence. Table 4 shows examples:

TABLE 4 EXAMPLES OF VERB CONJUGATED

Arabic sentence	Arabic structure	Malay sentence	Malay structure
أكلت وجبات سريعة	V PRO N ADJ	Saya makan makanan segera	PROV N ADJ
أعاني من ألم البطن	PRO V PREP N1 N2	Saya menderita sakit perut	PRO V N1 N2

The first example is answering of the doctor question " هل اكلت اكل من الخارج؟"/ "*adakah anda makan makanan dari luar?"*. In this example the subject pronoun (ت) appears as suffix in the verb (اكل) and refers to first person (انا) will be translated to (saya makan). While a second example is answering of the doctor question "كيف أستطيع مساعدتك؟"/ "*Bagiamana saya boleh bantuan anda*?". In the example the verb conjugated (أ) appears as prefix in the verb (عانى) refers to first person pronoun (أنا) translated to (saya menderita). At the same time, there is a verb conjugated indicated to future tense in Arabic that appears as the verb prefix (سـ) and translated to "akan" in Malay. Table 5 shows an example

TABLE 5 AN EXAMPLE OF FUTURE TENSE

Arabic sentence	Arabic structure	Malay sentence	Malay structure
سأعطيك دواء للاصداع	V PRO N1 PREP N2	Saya akan memberi anda ubat untuk sakit kepala.	PRO AUX V PRO N1 PREP N2

2.2.3 Adjective & Adverb Ordering

The adjective and adverb appear in a nominal dialogue sentence and verbal dialogue sentence. In both sentences adjective and adverb have reversed ordering in Arabic and Malay. Whereas the Arabic adverb follows the adjective [11] but in Malay the adjective follows the adverb[7]. Table 6 shows the following sentence in the first example "صحتك جيدة جدا" *"kesihatan anda sangat baik"* .This sentence is a nominal dialogue sentence occurs from doctor answering on the patient question "كيف صحتي دكتور؟". "Bagaimana kesihatan saya Doktor". Second example is "الم بطني شديد جدا" "sakit perut saya sangat kuat", this sentence is answering for the doctor question"كيف الم بطنك اليوم؟" "Bagaimana sakitperut anda hari ini?"

TABLE 6 EXAMPLES OF ADJECTIVE & ADVERB ORDERING IN A DIALOGUE

Arabic sentence	Arabic structure	Malay sentence	Malay structure
صحتك جيدة جدا	N PRO ADJ ADV	kesihatan anda sangat baik	N PRO ADV ADJ
الم بطني شديد جدا	N1 N2 PRO ADJ ADV	Sakit perut saya sangat kuat	N1 N2 PRO ADV ADJ

Table7 shows adjective and adverb ordering in the verbal dialogue sentence. The example is "أشعر بصداع شديد جدا" "saya merasa sakit kepala sangat kuat" that is a dialogue sentence for doctor question "مادا تشعر اليوم؟" "apakah anda merasa hari ini? "

TABLE7 SHOWS EXAMPLES OF ADJECTIVE AND ADVERB ORDERING IN A DIALOGUE

Arabic sentence	Arabic structure	Malay sentence	Malay structure
أشعر بصداع شديد جدا	V PREP N ADJ ADV	Saya merasa sakit kepala sangat kuat	PRO V N ADV ADJ

2.3 Imperative Type

This type is common used in a dialogue. The following table shows some examples:

TABLE 8 SHOWS EXAMPLES OF IMPERATIVE SENTENCES IN A DIALOGUE

Arabic sentence	Arabic structure	Malay sentence	Malay structure
خد دواك	V N PRO	mengambil ubat anda	V N PRO
من فضلك قابلني مرة اخرى	ADV V PRO N	Sila berjumpa saya lagi	ADV V PRO N

Refer to the table 8, in the second example the verb conjugated"ني" that contacts with the verb "قابل" appears as verb suffix. The translation to Malay is "saya" and appears separately after the verb "berjumpa".

2.4 Exclamatory Type

Exclamatory sentence is rarely used in expository writing and more common in dialogues as an incomplete sentence or single word. All types of exclamatory sentencesare informal and ungrammatical. The following table shows examples.

TABLE 9 EXAMPLES OF EXCLAMATORY SENTENCE IN A DIALOGUE

Arabic sentence	Arabic structure	Malay sentence	Malay structure
ساعدني دكتور!	V PRO N	membantu saya doktor!	ADV V PRO N2
مادا!	Q W	Apa	Q W

3. METHODS AND MATERIALS

The overall process of Arabic Malay Dialogue Translation system (AM-DTS) was illustrated in figure1 based on Rule Based approach.

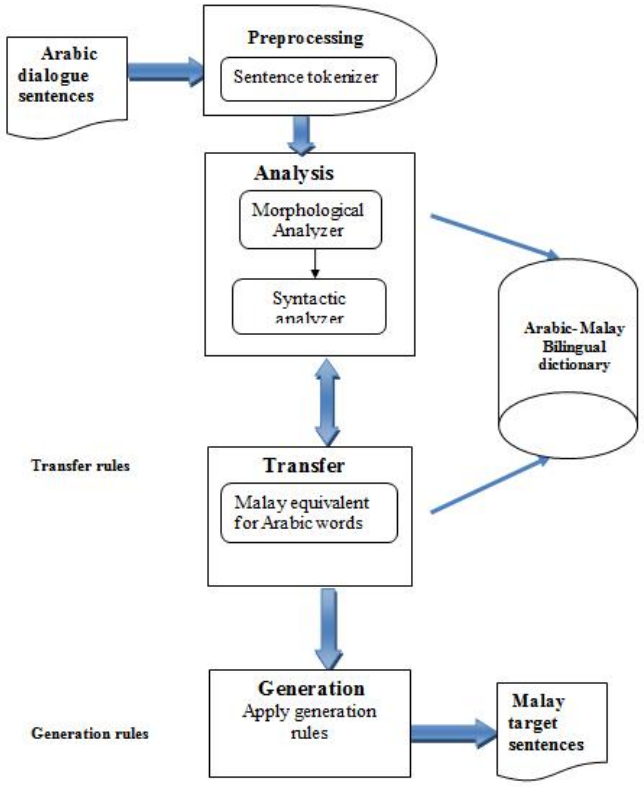

Fig.1 : AM-DTS architecture

The processes of MT start from input source text to generation of output target text. The processes of Arabic to Malay dialogue translation system are as following:

3.1 Source Language Phase

Analysis of the source language input is in order to recognize the structure of the sentence.

3.1.1 Divide The Input Text Into Words

The system performs the preprocessing task before going to the analysis phase that is the tokenization process. The tokenization process depends on split the sentence into words (tokens). The token can be a word or a part of a word [3].

3.1.2 Morphological Analysis

The Arabic morphological analysis is a complex morphology and each word in Arabic text has more than one morphological analysis [5]. Morphology depends on analysis of each word and determines the relationships of words; this process takes all attributes specific to each word in the source sentence. The analyzing of words in a MT system converts the grammatical data into output that analysis thestructure of text [4]. Also morphological analysis needs to identify words in a text in order to determine their syntactic and semantic properties [17]. In our system morphological analysis analyzes the word by removing the affix from it in order to get its stem word form. Then identify its category and its features by using lexicon database. Table 10 shows an example of a morphological analysis for some words.

TABLE 10 EXAMPLES OF MORPHOLOGICAL ANALYSIS

The Arabic word	Analysis of the word
مساعدتك	مساعدت + ك
اكلت	اكل + ت
تشعر	ت +شعر
أعطيك	أ + عطي + ك

3.1.3 Dictionary

A dictionary is a large component of any MT system based on the quantity of information they hold [6]. In our system we will use the part of speech (POS) for each word in Arabic sentence that represent the structure of source language and then can retrieve the

corresponding target language structure (Malay). Each word is stored in dictionary as stem word (roots). The following table shows an example of our dictionary.

TABLE 11 EXAMPLE OF DICTIONARY

Arabic-word	POS	feature	Malay-word
مادا	QW	-	Apakah
ألم	Noun	singular	Sakit
مساعدة	Noun	singular	Bantuan
أخد	Verb	Past	Mengambil
شديد	Adj	-	Kuat
هدا	Det	Singular/masculine	ini
من	Prep	-	Dari
جدا	Adv	-	Sangat

3.1.4 Syntactic Analysis

Syntactic analysis deals with the order and structure of a sentence [1]. The syntactic analysis of AM-DTS system analyzes the phrasal structure and category of the Arabic sentence. In addition grammatical rules are produced from analysis of Arabic sentence that is dialogue sentence in our system, dialogue sentences can be interrogative, a statement and imperative sentence. The table 12 shows an example of some patterns of a number of dialogue sentences.

TABLE 12 AN EXAMPLE OF PATTERNS IN A DIALOGUE SENTENCE

Arabic dialogue sentence	Pattern
ما لسمك؟	QW N PRO
مادا تشعر اليوم؟	QW PRO V N
أعاني من صداع شديد	V PREP N ADJ
ساعطيك دواء للصداع	V PRO N1 PREP N2
أنت يجب ان تأخد الدواء	PRO V CONJ V2 N

The output of syntactic analysis in AM-DTS system is presented in a dialogue sentence "أعاني من صداع شديد" that is shown in figure 2.

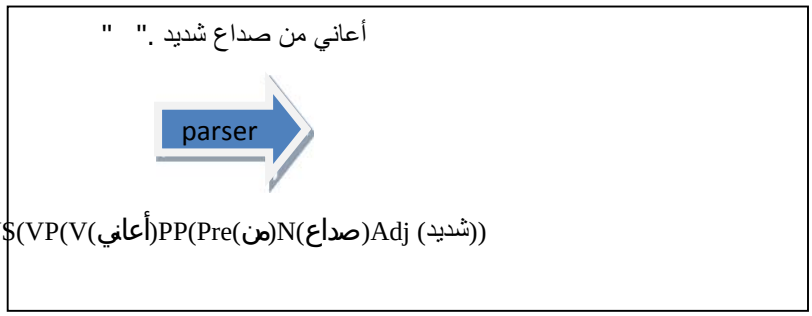

Fig 2 An Example of AM-DTS Parser

Through the figure above, VS presents Verbal sentence as type of a dialogue sentences. The symbol VP refers to Verb Phrase, NP refers Noun Phrase, PP refers to Preposition Phrase. The symbol N refers to Noun, Pre refers to Preposition, while Adj refers to Adjective.

3.2 Target Language Phase

In this process, sentences are generated from the target language that get the meaning of words from Bi-Lingual Dictionary and align the words based on target language rules. Generation of target output is a process of deriving linguistic expression whose meaning corresponds to informational structure that used as input [12].

3.2.1 The Transfer Components

Generally, the transfer components are a set of rules that relate words and structures in one language to words and structures in another language [2]. In our sentences translation the transfer phase appears how can convert the Arabic sentence structure into Malay sentence structure. Arabic to Malay transfer in our Rule based approach includes two steps:

3.2.1.1 Lexical Transfer

This process converts the Arabic lexical to their Malay equivalent in the same order as Arabic sentence that translated by using Bi-Lingual Dictionary . In lexical transfer of AM-DTS, the stems of the word in Arabic are taken with their categories from the bilingual dictionary in order to get an equivalent Malay meaning. Also based on the prefixes and the suffixes that are attached to the words. For example, a certain affixes can be attached to the noun that extract many features from it such as a number, gender ...etc). Despite, there are many affixes can be attached to the verbs

that describe it in a past, present or…etc. For example, the letter "ة" is an adjective suffix which refers to feminine gender such as"جيدة" (good) translated to "baik". The suffix"ت" is a verb suffix refers to past with second person singular such as "اكلت" (you ate) in Malay translated to "anda makan". The prefix "يـ" is a verb prefix refers to present tense with a third person singular subject such as "يشعر" (he feel) in Malay translated to "dia merasa". The prefix "تـ" is a verb prefixrefers to present tense with a second person singular subject such as "تشعر" (you feel) in Malay translated to "anda merasa".

The output of this step is Arabic words with their corresponding Malay words. The following figure shows an example of lexical transfer.

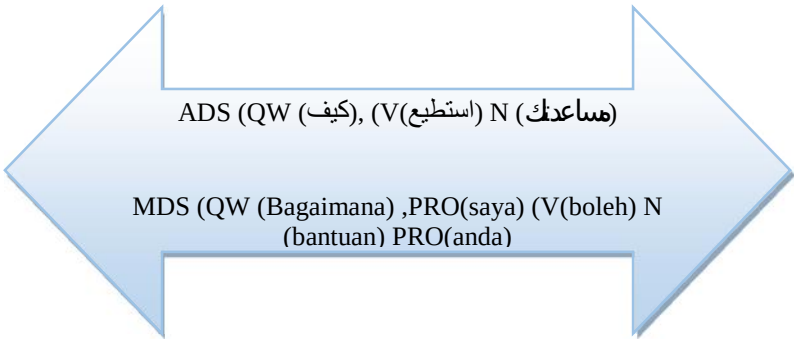

Fig 3 An Example of Lexical Transfer

Where, the symbol (ADS) refers to Arabic Dialogue Sentence and (MDS) refers to Malay Dialogue Sentence.

3.2.1.2 Structural Transfer

In this phase, aligning the target words according to target language rules, whereas the Malay words (lexical items) are not into the correct order and Arabic sentence is a well structure Arabic sentence. Consider this sentence as an example "الم بطني شديد"

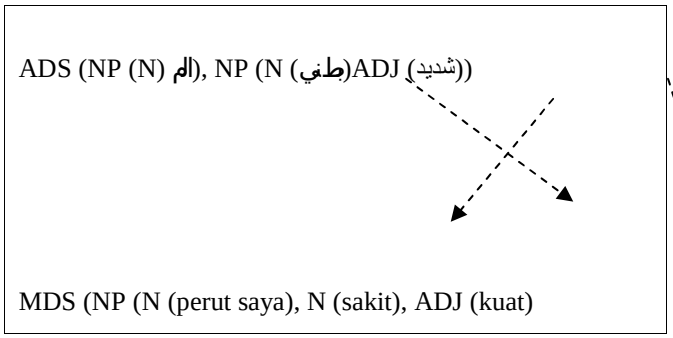

Fig 4 An Example of Structural Transfer

3.2.2 Arabic to Malay rules for dialogue.

There are set of rules of Arabic dialogue sentence to represent the Malay structure. The AM-DTS system has shown these rules with some examples to be more obvious.

Transfer Rule **1**: This rule states that for interrogative sentence in a dialogue, it has the pattern: [QW PRO V N PRO]. It should be transferred to the pattern: [QW PRO V N PRO] when translated to Malay. For example, the Interrogative sentence "كيف أستطيع مساعدتك؟ " which should be translated to" *Bagaimana saya boleh bantuananda?*" The transfer process of this sentence to the target language sentence is illustrated in Figure 5.

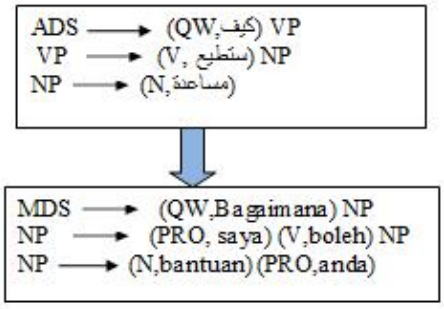

Fig 5 An Example of Transfer Rule1

Transfer rule 2: This rule also states for the interrogative sentence in a dialogue. It has the pattern: [QW N ADV] that transferred into the pattern [N ADV QW].

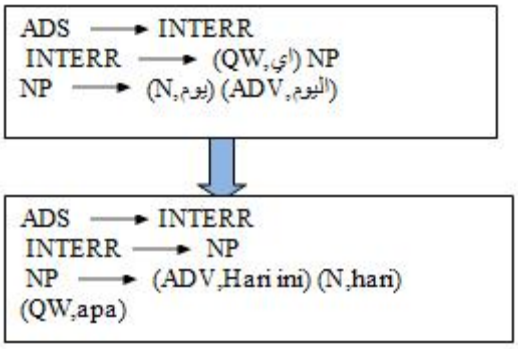

Fig 6 An example of transfer rule2

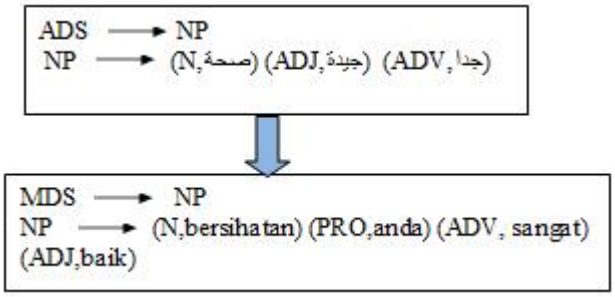

Fig 7 An example of transfer rule3

Transfer rule 4**:** This rule states that for verbal sentence in a dialogue. It has pattern: [V PREP N ADJ] as (VSO) order, the subject is dropped and appear as verb conjugated (أ) that related to verb (شعر). It should transfer to the pattern [PRO V N ADJ] when translated to Malay. For example, the dialogue sentenceأشعر بصداع شديد"" which should be translated to*"saya merasa sakit kuat*". The transfer process of this sentence to the target language sentence is illustrated in Figure 8.

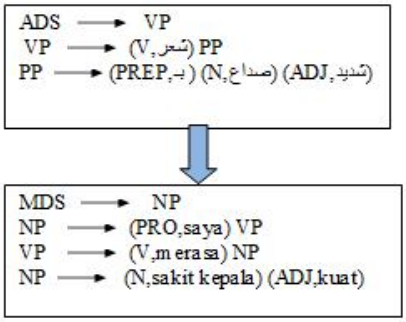

Fig 8 An example of Transfer Rule 4

3.2.3 The Generation Stage

The generation stage divides into two parts. These parts are syntactic generation and morphological generation. In this phase the target language should be correct structures grammatically and meaningful translations. Whereas the morphological generation produces inflected Malay words in their correct forms based on a set of grammar rules for the Malay language. Furthermore, the syntactic generation will produce the final structure of the Malay sentences. The following section shows examples of Malay morphological generation such as preposition generation rules, tense generation rules.

3.2.3.1 Preposition Generation Rules

If there are prepositions (من/from) or (في/in) in noun phrase will be removed when translated to Malay in some cases. Consider the sentences below:

The preposition 'في' sometimes removed when translated to Malay, such as: "أشعر الم في البطن" translated to *"say merasa sakit perut"*. The following rule has been added:

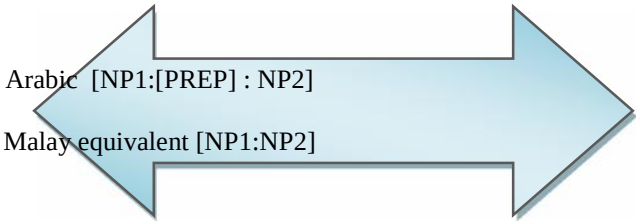

Fig 9 An example of Delete Preposition "في' Rule

In some cases, there is no Malay equivalent of preposition "من" in Arabic Such as: "أعاني من حساسية ادويه؟" will be translated to "*Saya menderita alergi ubat?"*. The following rule has been added.

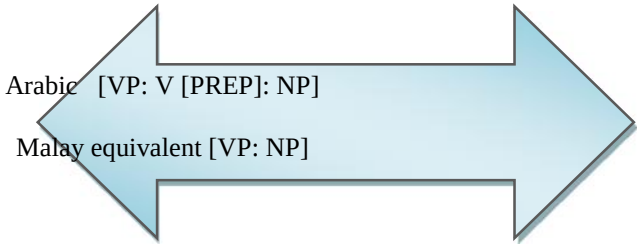

Fig 10 An example of Delete Preposition "من"Rule

3.2.3.2 Generation Rules Of Possessive Pronouns

These rules appear with nouns that contain possessive pronouns that are (ك/your, ي/my, هم/their, نا /our, ه/his, ها/her).

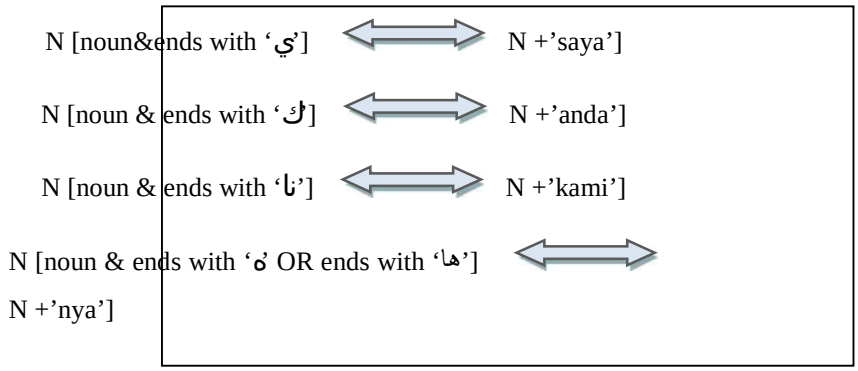

Fig 11 Representation of Possessive Pronoun Generation Rules

On the other hand, in Malay the possessive pronouns are not a attached to noun, they are as one word that are (anda/your), (saya/my) , (kami/our), (mereka/their). Except the possessive pronoun (nya/his or her) that connected to nouns. The following rules have been added.

3.2.3.3 Tense Generation Rules

Each verb in Arabic has a set of features that represents certain tense when translated to Malay. By the prefix and suffix that attach to the verbs additional information will be known about the verbs. We will describe the tense rules that have been generated in AM-DTS system as following.

- If the verb starts with "تـ" this means it refers to second subject pronoun, when translated to Malay we need to add the pronoun 'anda' before the verb. The following rule has been added [V [imperfect category & starts with 'تـ'] ⟺ 'anda' + V] such as: ماذا تشعر اليوم؟ apakah anda merasa hari ini?
- If the verb starts with (أ) this means it refers to first singular subject pronoun, when translated to Malay we need to add the pronoun "saya" .[V [imperfect category & starts with 'أ'] ⟺ 'saya' + V] Such as: أعاني من الم بطن saya menderita sakit perut
- If the category of the verb is perfect and the verbends with (ت), this means it refers to second subject pronoun; we need to add the pronoun "anda" when translated to Malay before the verb. The following rule has been added.[V [perfect category & ends with 'تـ'] ⟺ 'anda' + V] Such as: هل اخذت ادوية؟ adakah anda mengambil ubat?

4. RESULTS AND DISCUSSION

In order to evaluate the correctness of AM-DTS system the human judgement methodology will be used. Human judges compare with AM-DTS system output and assign scores. This methodology is based on sentence – by – sentence scoring and fluency scores from 0 to 10. Whereas 0 means non match, 10 is full match, and 7, 8, 9 means most match. The output accuracy of our system is around 87.2 percent for dialogues in medical domain. The rest 13 percent has problems. We applied on 50 dialogue sentences in medical domain. These dialogue sentences are classified into 20 interrogative sentences that are divided into 10 for yes/no question type and 10 for using question words in questions. 20 dialogue sentences for verb conjugated and 10 dialogue sentences for transfer adjective and adverb. We have got our dialogues from many sources. First the doctors in the clinic by asking them about the common questions that have asked for patients and expected answering. Second we have referred to some Arabic dialogue books in medical domain. Third we have met students in medical faculty in UKM for asking them expected doctor questions and patients answering. At all sources we are referred to Arabic Malay dictionary to get the proper meaning. The experiment gives the following results as shown in Table 13.

TABLE 13 RESULT OF AM-DTS SYSTEM

AM-RBMT system	
Total score	436
Overall percentage	87.2

TABLE 14EVALUATION OF AM-DTS SYSTEM

Dialogues	
1.كيف حالك؟	
Human translation	AM-DTS system
Apakhabar?	Apakhabar
Problem no	Problem no
Non	Non
Sub score	Sub score
10	10
2 .أعاني من ألم في البطن	
Human translation	AM-DTS system
Sayamenderitasakitperut	Sayamenderitadarisakit di perut.
Problem no	Problem no
Non	6
Sub score	Sub score
10	8
3. كم عمرك؟	
Human translation	AM-DTS system
Apakahumurawak?	Apakahumuranda?
Problem no	Problem no
Non	1
Sub score	Sub score
10	9
4 . اي يوم اليوم؟	
Human translation	AM-DTS system
Hari ini hari apa?	Apa hari hari ini?
Problem no	Problem no
Non	8
Sub score	Sub score
10	8
5.صحتك افضل من قبل	
Human translation	AM-DTS system
Kesihatan anda lebih baik daripada sebelum	Kesihatan anda baik dari sebelum
Problem no	Problem no
Non	2,6
Sub score	Sub score
10	8
6. أكلت وجبات سريعة	
Human translation	AM-DTS system
Saya makan makanan segera	Anda makan makanan segera
Problem no	Problem no
Non	9
Sub score	Sub score
10	6

We have faced many problems from mismatching between source and target dialogue. The problems are described below and we assign suitable scores for them based on matching between AM-DTS output and the human translation. Such as we will give 10 for match all and 9, 8, 7 for match most.

1. Translation of subject pronouns. Translation of subject pronouns sometimes makes different translation; it is the same meaning but different using of words.
2. Translation of preposition. The prepositions can have more than one translation and delete them from the translation in some cases.
3. Order of verb& subject.This problem appears because the verb and subject have different order.
4. Translation of dual words. This problem appears because the dual form in Arabic is by adding "ين" in some cases. At the same time the plural form also by adding "ين". That makes translation ambiguity.
5. The order of adjective& possessive pronoun. This problem appears because the adjective and the possessive pronoun that attaches to the noun are in different ordering. Whereas the adjective appears after the possessive pronoun that is not translated in right order. So we need to restructure the adjective with possessive pronoun.
6. Addition and deletion.This problem appears when we need to add or delete words from system depend on the corresponding translation with human.
7. Order of demonstratives. This problem appears because the demonstrative "هذا/ini" ,"ذلك/itu" appear in the front of a noun

phrase in Arabic that is not translated in right order. So we need to reorder the demonstrative with noun.

8. The order of noun & adverb: this problem appears because the noun and adverb have different structure in some cases.
9. Ambiguity of verb conjugated: this problem appears, because the verb conjugated sometimes return to first person pronoun for masculine. Otherwise return to second person pronoun masculine.

The Table 14 shows part of the result produced by this experiment

5. CONCLUSION

This paper has been focussed on issues in the implementation of a Rule-based MT system, which translates the Arabic dialogue into Malay. The dialogue consist of four types interrogative, imperative, statement or exclamatory sentences. We proposed a rule-based approach to solve the problems in the dialogue translation from Arabic to Malay. We used to automate the translation of set of dialogues of 50 sentences from different sources and that system get 87.2% of correct translation. In future works, Increase the entries of lexicon to cover more area of domain that as our dictionary focused on dialogs in medical domain only, Solve the ambiguity of the subject pronoun (ت) that attach to verbs. Whereas can be appear as a second person pronoun or first person pronoun, and solve the problems that appear in our system, those are translation of preposition, order of verb, translation of subject pronouns, translation of dual words ,the order of adjective and possessive pronouns. These improvements will achieve the correctness of the translations from 87.2-100%.

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