

Evaluation Of Machine Translation Systems Presented

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Abstract

The research aims at drawing some quality assessment of the MT systems considered and the problematic issues and difficulties such systems encounter in the translation process. The inadequacy of the lexicon and the linguistic components of a MT system affects the quality of the whole system. The evaluation of cognitive and linguistic capabilities of a MT systems is an essential issue for the process of evaluating MT systems. The results of the evaluation confirm that there are still serious drawbacks with these systems. With the application of modern ideas of MT, currently is gaining momentum. MT products are now receiving a considerable amount of interest and many systems are intended to be used by humans to assist them in performing some translation tasks or achieving certain goals. A great deal of activities around MT, is evaluation initiative. Their object is an individual or comparative assessment of system performance and of the quality of linguistic output. This reflects how well the MT systems perform the requirements for which it was designed.

1-Machine Translation

1-1 What is Machine Translation?

Machine Translation is the application of computers to the translation texts from one natural language into another (W. John Hutchins) .

(Arnold D . & L. Balkan 1994) defined MT as the attempt to automate all, or part of the process of translation from one human language to another.

MT is the process that utilizes computer software to translate a text from one natural language into another. This definition accounts for the grammatical structure of each language and uses rules and assumptions to transfer the grammatical target language "translated text"

(<http://www.essex.ac.uk/linguistics/C/mt/MTbook/>).

In recent years machine translation, a major goal of natural language processing has met with limited success. Most machine translation involves some sort of human intervention, as it requires a pre- editing and post- editing phase; so in machine translation, the translator supports the machine.

In field with highly limited ranges of vocabulary and simple sentence structure, machine translation can deliver useful result.

1-2 Why Machine Translation ?

It is an important topic, socially, politically, commercially, scientifically and intellectually or philosophically and one whose importance is likely to increase as the 20th century ends, and the 21st begins.

Theorists, developers and sellers of MT systems must be mainly responsible for any level of ignorance and lack of uptake, and we hope that this research will help here and one motivation for writing this research is the belief that any understanding of MT is an essential part of the equipment of a professional translator (D.Arnold; L. Balkan 1994).

1-3 How MT System Works?

Translation is not mere substitutions for each word, but being able to know "all of the words" in a given sentence or phrase and how one may influence the other. Human languages consist of morphology " the way words are built up from small meaning – bearing units", syntax " sentence structure" , and semantics (meaning). Even simple texts can be filled with ambiguities.

It is argued that the problem of MT requires the problem of natural language understanding to be solved first. However , a number of heuristic methods of MT work well including:

- Lexical Lookup methods.
- Grammar based methods.
- Semantics based methods (knowledge – based MT).
- Statistical methods.
- Example based methods.

In general terms, rule-based methods (the first three) will parse a text, usually creating an intermediary, symbolic representation, from which it then generates text in the target language. This method requires extensive lexicons with morphologic, syntactic and semantic information and large sets of rules. Statistical based methods (the last two eschew manual lexicon building and rule writing and instead try to generate translation based on building text corpora.

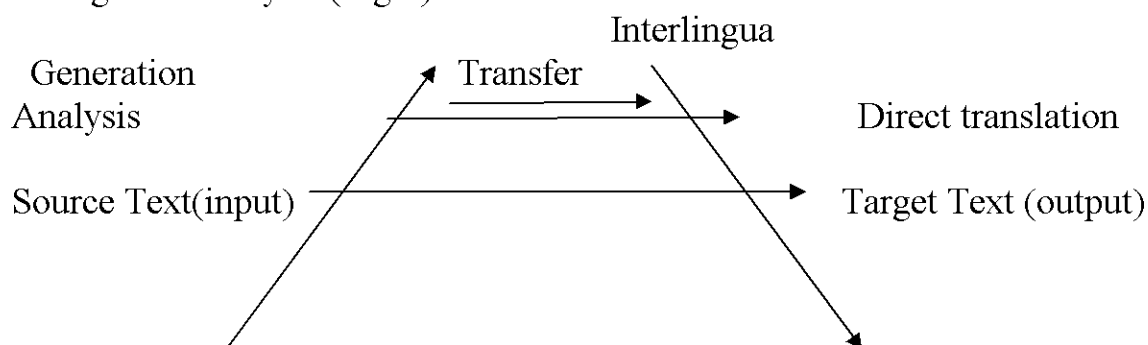
Given enough data, most MT programs work well enough for a native speaker of one language to get the approximate meaning of what it is written by the other native speaker. (Form: [http://en2.Wikipedia.org/wiki/machine translation](http://en2.Wikipedia.org/wiki/machine_translation)).

1-4How Accurate is Machine Translation?

According to Gartner, MT tools have a 60% -80% accuracy rate depending upon the type of document being translated. Because of the difficulties in translation due to ambiguity, word order, sentence context etc .,machine translation effectiveness is limited to certain situations but not in situations requiring a high degree of accuracy or using informal text (from [http://www.gii.co.ip/English/ab10693 language translation toc. html](http://www.gii.co.ip/English/ab10693_language_translation_toc.html)).

2- Machine Translation Approaches

The Vaugouis triangle for the classification of MT system according to the level of linguistic analysis (Fig.1)



(Fig.1)

Bernard Vauquois' pyramids showing comparative depths of intermediary representations, interlingua machine translation as the peak, followed by transfer based, then direct translation.

Machine translation can use a method based on linguistic rules, which means that words will be translated in a linguistic way, the most suitable words of the target language will replace the ones of the source language. It is argued that the success of machine translation requires the problem of natural language understanding to be solved first. Generally, rule – based methods parse a text, usually creating an intermediary, symbolic representation, from which the text in the target language is generated.

According to the nature of the intermediary representation, an approach is described as interlingua machine translation or transfer – based machine translation. These methods require extensive lexicons with morphological, syntactic and semantic information, and large sets of rules. Given enough data, machine translation programs often work well enough for a native speaker of one language to get the approximate meaning of what is written by the other native speaker.

2-1 Rule – Based Method

The rule- based machine translation paradigm includes transfer- based machine translation, interlingua machine translation and dictionary- based machine translation paradigms.

2-2 Interlingua Machine Translation Method

Interlingua machine translation is one instance of rule- based machine translation approaches. In this approach, the source language, i.e. the text to be translated, is transformed into representation. The target language is then generated out of the interlingua.

2-3 Dictionary – Based Machine Translation Method

Machine translation can use a method based on dictionary entries, which means, that the words will be translated as they are by a dictionary.

2-4 Statistical Machine Translation Method

Statistical machine translation tries to generate translations using statistical methods based on bilingual text corpora where such corpora are available, impressive results can be achieved in translating texts of a similar kind, but such corpora are still very rare. The first statistical machine translation software was CANDIDE from IBM. Google used SYSTRAN for several years, but switched to a statistical translation method in October 2007.

2-5 Example Based Machine Translation Method

Example- based machine translation (EBMT) approach was proposed by Makoto Nagao in 1984. It is often characterized by

its use of a bilingual corpus as its main knowledge base, at run- time. It is essentially a translation by analogy and can be viewed as an implementation of case – based reasoning approach of machine learning expressed in a declarative grammar formalism ; and grammars clearly supply each accessible string with an implicit structural description (Gazder and Mellish, 1989:100).

There are about ten grammatical strategies of computer language, which consider " sentence" as an analysis unit. Some of these strategies are derived from NLP such as" Case Grammar", Semantic Grammar" and "Transformational – Generative Grammar". Others are derived from "Artificial Intelligence (AI)" and are not based on any psychological theory by which human learns language.

3-Machine Translation Systems

Machine Translation Systems can be defined as any computer based process to transform a text from one language into another language without human intervention.

The basic task of any machine translation system is to analyze the source text including morphological, syntactic and semantic.

analysis using special purpose lexicons and target language generation.

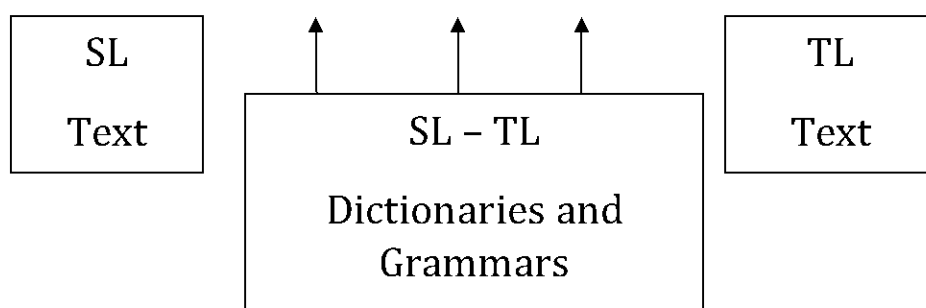
The automatic machine translation systems available today are not able to produce high quality translations, their output must be edited by a human to correct errors and improve phrasing. Computer assisted translation (CAT) incorporates with manual editing stages into software, making translation an interactive process between human and computer.

Some advanced computer assisted translation solutions include controlled MT. This type of technology is widely known amongst professional translators and technologists and also available to any individual translators who wish to invest in such technology. Carefully customized user dictionaries based on correct terminology significantly improve the accuracy of MT, and as a result aim at increasing the efficiency of the entire translation.

This part is specifically concerned with the general methods that have been adopted for the analysis of texts. Many operations are performed to identify all words of the input and determine whether the grammatical structure of the input is consistent with the acceptable grammatical rules.

3-1 Direct Translation Systems

These systems were employed in nearly all MT systems until the late 1960s. Systems were designed to the least details specifically for particular pair of languages. The basic assumption was that the vocabulary and syntax of SL texts need not be analyzed any more (Hutchins, 1989:3). This system is seen in the early word – for – word system in which essentially each word of the SL text was substituted by a word selection of words in the TL . figure(2) below illustrates the stages of the system.



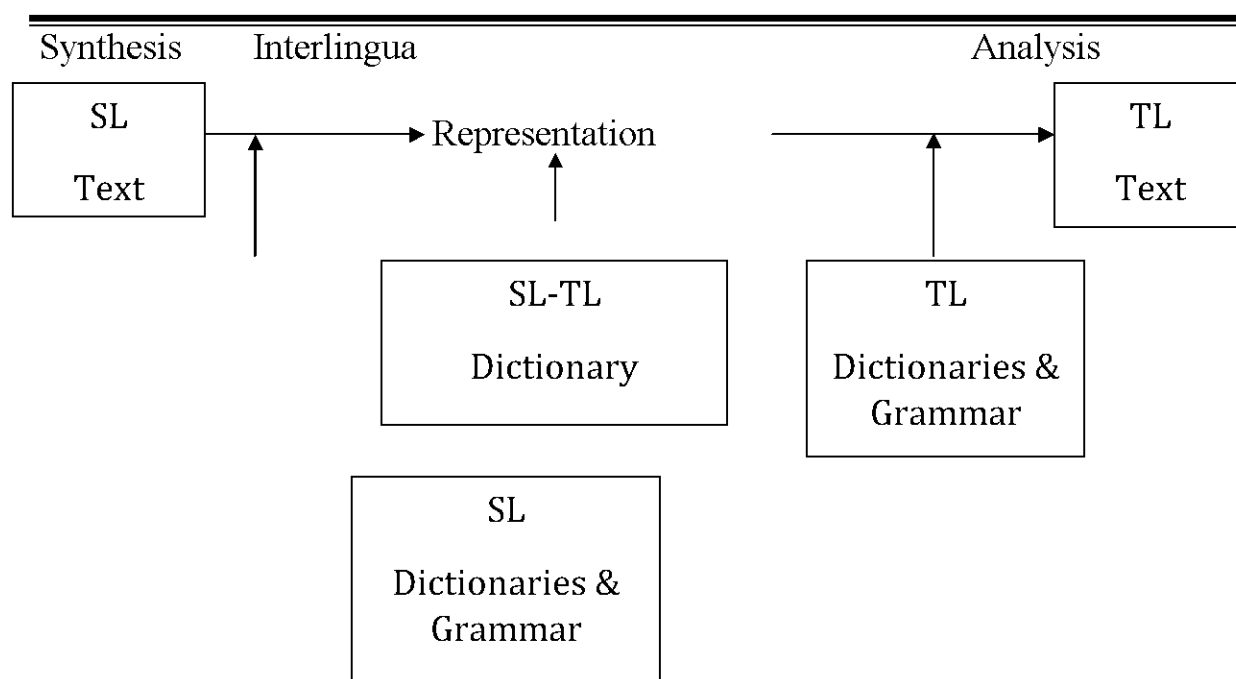
Fig(2) Direct Translation Systems. From Hutchins (1989:4)

3-2 Indirect Translation Systems

The achievement of theoretical linguistics in the early 1960s seemed to promise considerable improvements in MT systems. Research started on indirect translation system in which SL text analysis and TL text generation are kept separate and conversion is achieved via an interlingua representation or transfer component operating on abstract intermediary SL and TL representation (Hutchins, 1989:4).

3-3 Interlingual System

This system assumes the possibility of converting SL text into semantic – syntactic representation common to more than one language. From such interlingua representation, text would be generated into other languages. Translation from SL to TL in such systems requires two stages: in the first stage, SL text are fully analyzed into interlingua representation, and in the second stage, interlingua forms are the sources for producing TL texts (Hutchins, 1989:5).

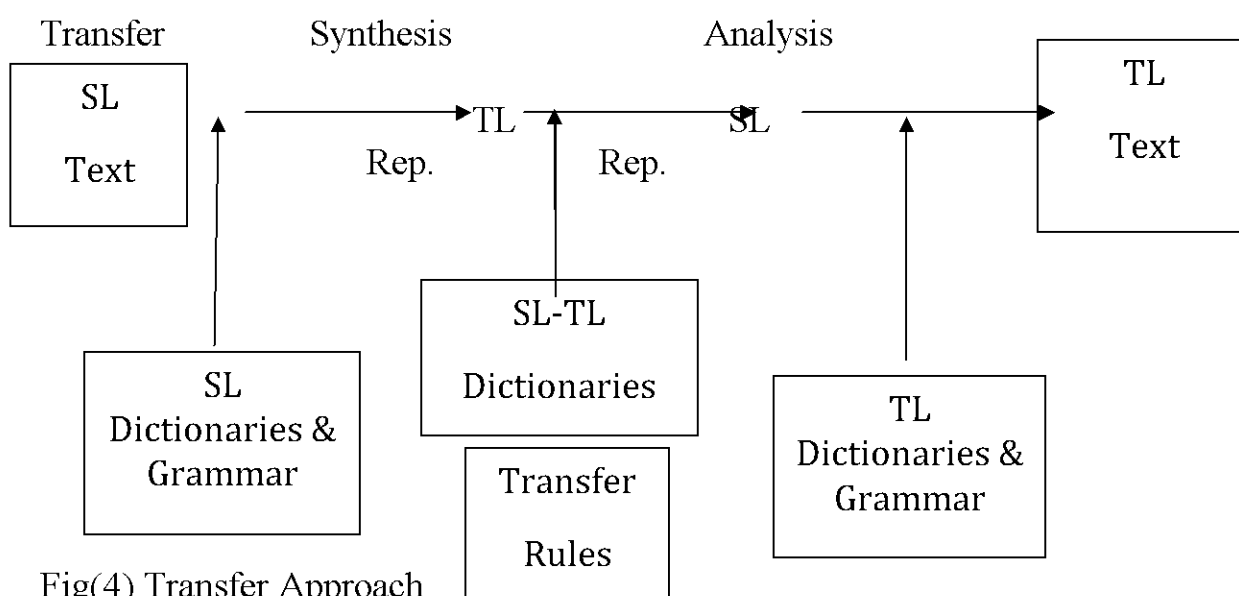


Fig(3) interlingua system

(From Hutchins,1989:5)

3-4 Transfer System

In this system, there are three stages involving underlying representation for both SL and TL : the first stage converts SL texts into SL deep representation, the second stage converts these into TL deep representation, and the third produces from these the final TL text from (Hutchins,1989:5). Whereas the Interlingua approach requires complete resolution of all ambiguities of SL text so that translation should be possible into any other language. Fig (4).



Fig(4) Transfer Approach

(From Hutchins,1989:5)

4-Methods of MT Translation Evaluation Systems

4-1. Evaluation of Different MT Aspects and MT Output Quality

EL-Hadi (2001), in France, examined some of the problems encountered in designing an evaluation for an MT system. The ST , in French, dealt with biotechnology and animal production. It is translated into English. The output of the system (i.e., the result of assembling of several components),as opposed to its individual modules or specific components(i.e., analysis, generation, grammar,core,lexicon,etc.),was evaluated. The evaluation concentrated on translation quality and it's fidelity to the ST.It was not a comparative evaluation. It was only a test of specific MT system.

Reeder et al.(2001) reported the results of an experiment in MTE, designed to determine whether easily/ rapidly collected metrics could predict the human generated quality parameters of MT output. In this experiment, they evaluated a system's ability to translate named entities, and compared this measure with previous evaluation scores of fidelity and intelligibility. There were two significant benefits potentially associated with a correlation between traditional MT measures and named entity scores:

- a) The ability to automate named entity scoring and thus MT scoring.
- b) Insight into the linguistic aspects to task-based uses of MT.

4.1.1. ISLE- Based Evaluations

Evaluation guidelines for a given domain or task must be rooted in a general model for software evaluation.

Following the guidelines for MT evaluation proposed in the ISLE taxonomy,(Brucker and Plitt 2001) presented considerations and procedures for evaluating the integration of machine- translation segments into a larger relation workflow with translation memory (MT) systems.

Miller and Vanni (2001) focused in their study on the selection of MT output features suggested in the ISLE framework to develop metrics for the multi-dimensional characterization of MT quality. They defined each metric and described the rational for its development. They also discuss several of the finer points of the evaluation measures that arouse as a result of verification on the measures against sample output texts from three MT systems.

4.1.2 Automatic Evaluation of MT Systems

In 2001, Reeder aimed at testing the efficiency of applying automated evaluation techniques, originally designed from human second language learners to MT systems evaluation. The researcher believed that such evaluation techniques would provide insight into MTE, MT development, the human translation process and the human language learning process. The experiment described only intelligibility of MT output. The evaluation technique was derived from a second language acquisition experiment that showed that assessors could differentiate native from non native language essays in less than

100 words. The researcher duplicated this experiment to see if similar criteria could be elicited from duplicating the test using both human and MT outputs on the decision set.

Approaches to the automation of MTE were attempted by White and former (2001) to connect some rapidly measurable phenomenon with general attributes of the MT output and / or system. In particular, measurements of the fluency of output were often asserted to be predictive of the usefulness of MT output in information – intensive, downstream tasks. The connections between the fluency (intelligibility) of translation and its informational adequacy (fidelity) were not actually straightforward.

The new trend in MTE points to the need for the development of evaluation methodologies that minimize the amount of subjectivity as much as possible. It is believed that the best way to achieve this goal is to automate, as much as possible, any evaluation task or part thereof.

In fact, whatever new methods may emerge, and whether methods will ultimately be unnecessary, it is clear that evaluation will remain very near the centre of MT awareness.

5. Adaptive Arabic- English Cross- Language Information Retrieval (CLIR)

CLIR is to enable users to query in the Arabic language against an English collection. To achieve this goal, we investigate two techniques namely the use of Machine Readable Dictionaries (MRD) and MT based approaches.

In the MRD realm, we consider three possible techniques: the Every – Match (EM), the First-Match (FM), and the Two- Phase (TP) methods. The Every-Match method considers all the translations found in a bilingual dictionary. This leads to ambiguous translations because it introduces extraneous terms to the target query and yields relatively poor effectiveness. Another method is the First- Match method. Instead of considering all the target language equivalents in the bilingual dictionary, we use the first match in the bilingual dictionary as the candidate translation of the source query term. This approach takes advantage of the fact that dictionaries typically present the translations in the order of their common use.. The FM method ignores some of the less common translations of the source language and thus, improves the retrieval effectiveness. The Two- Phase method initially considers all the translations found in the bilingual dictionary as candidate terms then removes the translated candidate terms that do not return the original source query term. We found that the TP approach consistently outperforms the EM and FM methods. In addition to MRD , we also evaluated the effectiveness of Arabic to English MT- based method.

Arabic words are classified into nouns (adjectives and adverbs), verbs, and particles. All verbs and some nouns are derived from a root. Arabic sentences

are either verbal or nominal. Verbal sentences contain a verb before a nominative noun (the subject), and may contain complements. Nominal sentences begin with a subject followed by a noun, an adjective, a prepositional phrase, or an adverb. In formal writing, Arabic sentences are delimited by commas and periods as English, for instance:

Arabic – English CLIR means the retrieval of documents based on queries formulated by a user in the Arabic language, and the documents are in the English language.

5-1 Cross- Language Information Retrieval(CLIR)

In (CLIR), either documents or queries are translated. There are three main approaches to CLIR: machine translation, comparable or parallel corpus, and machine readable dictionary. MT systems seek to translate queries from one human language to another by using context. Disambiguation in machine translation systems is based on syntactic analysis. Usually, user's queries are a sequence of words without proper syntactic structure.(Pirkola,A) Therefore, the performance of current machine translation systems in general language translation makes MT less than satisfactory for CLIR (Oard D.w. 1998).

Dictionary- based methods perform query translation by looking up terms on a bilingual dictionary and building a target language query by adding some or all of the translations. The practicality of dictionary- based translation is increasing due to the greater availability of machine- readable bilingual dictionaries. Moreover, the topic coverage of this technique is less limited than that of parallel corpus since a dictionary typically contains a wider variety of terms than a sample corpus. (Pirkola,A)

5-2 Dictionary – Based Method

The behaviors of certain techniques differ across languages, particularly languages from different origins, and our focus is strictly on Arabic – English processing. In spite language differences, adapting successful approaches from other languages to Arabic should be investigated. Thus, we adopt some of the prior dictionary – based CLIR approaches.

5-3 Every – Match Method

The Every – Match (EM) method studies the effects of simple word – by word translation on Arabic – English retrieval performance by translating Arabic queries word – by word via a MRD. Dictionary definitions often provide many senses for a single word. In this method, we retain every possible translation when more than one alternative is present, namely, we replace each term with every exact term match in the bilingual term list.(Hull,D.1996.)and(Oard,D.w.1998). For example, (incandescent light bulb) after translation into Arabic appears as (مصباح) .

ضوئي وهاج

In Table 1, we illustrate the EM method via an example. The Arabic query words are translated by replacing them by their target English language equivalents. As shown in Table 1, the simple dictionary translation via MRD yields ambiguous translations. It is obvious that the number of word senses increases when the Arabic language word is translated to a target English language by all the equivalents.

Arabic Terms	EM Method
مصباح	Lamp light burner
ضوئي	Brightness light gleaming glow illumination
وهاج	Glowing incandescent candescent candent ardent fervent white – hot red- hot blazing flaming radiant brilliant bright resplendent flamboyant glaring dazzling glittering glistening sparkling flashing .

Table 1. Terms of the original Arabic query, and the result of the EM method

5-4 First – Match Method

In the First – Match (FM) method, only the first match translation per query term is retained instead of using all of the listed translations.(Ballesteros,L.,and Croft,B.)and (Oard,D.) In Table2, we illustrate an example of the Arabic query (مصباح ضوئي وهاج) and the translations obtained using the First- Match Method. As illustrated, in this case, the translations obtained by the FM method appear more precise than those obtained via EM method.

Arabic Terms	FM Method
مصباح	Light
ضوئي	Brightness
وهاج	Glowing

Table 2. Terms of the original Arabic query, and the result of the FM method

5-5 Two – Phase Method

To reduce the ambiguity of the every match method, but to loosen the inherent restrictions of the first match method, we introduce a method that uses some, but not all of the translations of a given Arabic term. The underlying assumption behind the Two- Phase (TP) method is that:

$f^{-1}(f(x)) = x$, namely, the translation of the translation of the term should yield the original term. If this condition holds, the translation is valid and does not introduce drift or noise.

Let A represents the original Arabic terms.

Let E represents the translated English terms of A using the Every – Match method.

Let A' represents the translated Arabic terms of E using the Every – Match method.

Then, the Two – Phase method can be implemented as follows:

Translate original Arabic terms A into English terms E using the Every – Match method via an Arabic – English dictionary.

Translate the English term E to the Arabic terms A' using the Every – Match method via an English – Arabic dictionary.

Return the original Arabic terms A, and the translated Arabic terms A', to their infinitive form.

A candidate English term of E is one that it yields to its original Arabic term based on the comparison between A and A'.

In the rare case when the original terms do not yield a candidate translation term, the following modification is incorporated into the algorithm:

1- If an English term in E does not yield its original Arabic term in A, then:

Find the synonyms of the English term; translate them using the Every – Match method, each translated synonym that matches the original Arabic term A is selected as candidate translation.

2- If neither the English term nor its synonyms in E yield the original term, use the first match term in E as a candidate translation.

In Table 3, we illustrate an example of the original Arabic query (مصباح ضوئي) , as translated by the TP method.

Arabic Terms	FM Method
مصباح	lamp light
ضوئي	Light
وهاج	Glowing, incandescent, candescent, candent, ardent, fervent, red-hot, blazing, flaming radiant, flamboyant glaring, flashing

Table 3. Terms of the original Arabic query, and the result of the TP method.

As shown in Tables 1, 2 and 3, the TP method removes 13 terms from all possible translations found in the dictionary. The term burner results from the translation process of the original Arabic term (ضوئي) using the machine – readable dictionary. This term is a noise term since it is irrelevant to original query. Similarly, the terms "brightness gleam glow illumination white – hot brilliant bright resplendent dazzling glittering glistening sparkling" are filtered out reducing the extraneous terms.

6- proposed Adaptive MT System

The adaptive systems is one of the artificial intelligent system that uses the population as a base to build the system. Neural networks and genetic algorithms are the famous methods to represent the adaptive systems.

In our work we propose an adaptive system that could be liable to be amended. For example, if we insert a word to the system which is not existed in the data base of the system it will send an instruction to the editors to insert this word

within the information data base so the number of words is increased with one word.

6-1 Experimental Approach

The translation process is done by translating each part of the query topic separately to notice whether this word is existed in this system or not. In Table 4, we show that the phrase is existed in the dictionary or not.

Original Arabic phrase	قسم علوم الحاسبات
Translated English phrase	Department of computer sciences

Table 4. Terms of the title field of the original Arabic phrase and the translation using MT system.

Original Arabic phrase	النقل متعدد الموجات
Translated English phrase	Not found in MT system

Table 5. Description field of the original Arabic phrase and the translation, using MT system (not found).

6-2 Results of the MT- based Method

In Table 7, we summarize the average precision results for the TREC-7 collection and topics (300-400). The adaptive machine translation results are better than the machine translation and Every- Match method (EM) in all runs. It yields to 0.1529 of adaptive MT. As shown in Table 7, both the FM and TP methods outperform the machine translation approach. The reason behind the degraded effectiveness of the machine translation is that the used machine translation system is designed to perform best on well- formed sentences or at least any sequence of words that form a context.

	Average Precision
Original	0.1737
EM	0.0895
FM	0.1197
TP	0.1243
MT- title	0.1066
Adaptive MT	0.1529

Table 7. Average precision of phrases 300-400.

Machine – readable dictionaries are cost effective as compared to the other methods such as parallel corpus, and Latent Semantic Indexing (LSI). The resources needed are readily available. The ambiguity introduced by the Every-Match (EM) method yields poor effectiveness; it achieved roughly half of the performance of the monolingual retrieval. A key factor affecting this is the transfer of too many senses that are inappropriate to the phrase because some words are not existed in the data base of the MT system..

It is common for a single word to have several translations, some with different senses. we proposed a new method called AMT method that achieve 0.1529 average precision than the EM, FM, TP and MT.

7-Conclusions and future works

In conclusion that use of electronic technologies is not a universal panacea for all the problems in translation. Despite their efficiency and outlooks, the translation software and electronic means cannot replace the human translator and guarantee high-quality translations. Their aim is to accelerate and facilitate the translation process, to solve many problems appearing in the course of the process and to minimize the time needed for translation.

A high-quality translation results from the combination of electronic technologies and the translator's skills, of good knowledge of a foreign language and theory of translation and because programs and translation software will not replace humans even in the long-term future, at least not until actual high-performance artificial intelligence is created. Therefore, much depends on the translator's personality and his professional experience, while electronic systems are useful, necessary and sometimes required supplements.

The results of the evaluation confirm that there are still serious drawbacks with these systems. With the application of modem ideas of AMT, currently is gaining momentum. MT products are now receiving a considerable amount of interest and many systems are intended to be used by humans to assist them in performing some translation tasks or achieving certain goals. A great deal of activities around MT, is evaluation initiative. Their object is an individual or comparative assessment of system performance and of the quality of linguistic output. This reflects how well the MT systems perform the requirements for which it was designed.

For future works we suggest the followings:

- In translation , researchers can penetrate a very significant topic concerning problems facing translators , namely the problem of am- biguity and to study the possibility of proposing MT system tackling this problem.
- A great deal of research in the field of MTE is essential to discover the capabilities of the currently existing MT systems, their shortcomings and potentiality of improvements. Therefore further study is necessary to be done in the topic of this research.
- Specific dictionaries should be created in order to evaluate the impact of specific terminology when integrated to MT system and after having run the system with the basic bilingual dictionary. There results will give us comparative data to evaluate the impact of the addition of a domain specific dictionary to MT system and in particular, the influence of specific terminology over the total quality of the translated output.

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