TRANSLATABILITY OF ARABIC FIXED EXPRESSIONS IN THREE NOVELS INTO ENGLISH USING NEURAL MACHINE TRANSLATION

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by

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LIST OF ABBREVIATIONS

AFE	Arabic Fixed Expressions
CTT	Computerized Translation Tools
FMT	Fully Machine Translation
HCI	Human Computer Interaction
HT	Human Translation
IEs	Idiomatic Expressions
IMT	Interactive Machine Translation
MSA	Modern Standard Arabic
MT	Machine Translation
NLP	Natural Language Processing
NMT	Neural Machine Translation
PEs	Proverbial Expressions
SLT	Source Language Text
SS	Syntactic Structure
SSAFE	Syntactic Structure of Arabic Fixed Expressions
SSAIE	Syntactic Structure of Arabic Idiomatic Expressions
SSAP	Syntactic Structure of Arabic Proverbs
SST	Seven Standards of Textuality
TDB	Terminology Data Bank
TLT	Target Language Text

KEBOLEHUPAYAAN UNGKAPAN TETAP BAHASA ARAB DALAM TIGA NOVEL UNTUK DITERJEMAHKAN KE BAHASA INGGERIS DENGAN MENGGUNAKAN TERJEMAHAN MESIN NEURAL

ABSTRAK

Ungkapan tetap Arab (AFE) digunakan secara tradisional untuk tujuan yang berbeza dalam situasi yang berbeza dan mempunyai makna kiasan simbolik yang tidak dapat diramalkan dari komponen individu atau makna literal dari bahagian penyusun. Kini banyak pengguna bergantung pada sistem NMT untuk menterjemahkan AFE kerana sistem ini menjadi bahagian penting dalam proses terjemahan. Walau bagaimanapun, terjemahan Mesin Neural (NMT) menimbulkan semacam kesukaran dan cabaran bagi mereka yang tidak mempunyai pengalaman yang cukup dalam terjemahan ungkapan tetap seperti peribahasa dan simpulan bahasa. Sistem terjemahan ini mungkin mewujudkan jurang antara Bahasa Sumber (SL) dan Bahasa Sasaran (TL). Terdapat pelbagai jenis sistem terjemahan Mesin Neural bergantung pada seni bina atau campur tangan manusia. Prestasi sistem NMT mungkin berbeza dari satu sistem ke sistem yang lain. Kajian ini bertujuan untuk mengenal pasti sistem yang paling berkesan di antara sistem Terjemahan Mesin Neural (NMT) terpilih yang dapat memberikan makna yang dimaksudkan dari Ungkapan Tetap Bahasa Arab (AFE). Lebih-lebih lagi, kajian ini menyelidiki struktur sintaksis Ungkapan Tetap Bahasa Arab (AFE), yang memungkinkan tahap ketepatan yang tinggi dapat dicapai dalam terjemahannya menggunakan sistem Terjemahan Mesin Neural (NMT) terpilih. Juga, kajian ini bertujuan untuk mengkaji masalah yang menghalang sistem NMT ketika menerjemahkan ungkapan tetap Arab ke dalam bahasa Inggeris. Halangan dan masalah seperti itu yang berkaitan dengan terjemahan ungkapan tetap menyebabkan

penghantaran mesej teks sumber tidak tepat. Untuk mencapai tujuan kajian ini, penyelidik memilih sampel peribahasa Arab dan simpulan bahasa dari tiga teks sastera yang akan diterjemahkan secara automatik oleh sistem NMT untuk mengukur dan menilai tahap ketepatan perisian ini secara khusus.

TRANSLATABILITY OF ARABIC FIXED EXPRESSIONS IN THREE NOVELS INTO ENGLISH USING NEURAL MACHINE TRANSLATION

ABSTRACT

Arabic fixed expressions (AFEs) have a symbolic figurative meaning that cannot be predicted from the individual components or the literal meanings of constituent parts. Many users nowadays rely on NMT systems to translate AFEs since these systems became an essential part of the process of translation. However, Neural Machine translation (NMT) creates a sort of difficulty and challenge to those who do not have enough experience in the translation of fixed expressions like proverbs and idioms. These translation systems might create a gap between Source Language (SL) and Target Language (TL). The study investigates the syntactic structure of the Arabic Fixed Expressions (AFEs), which allows a high level of accuracy to be achieved in its translation using selected Neural Machine Translation (NMT) systems. Also, this study seeks to identify the most efficient system to render the meaning of the (AFEs) extracted from the the three novels. Moreover, the study examines problems that hinder NMT systems when translating Arabic fixed expressions into English. In order to achieve the aim of this study, the researcher select samples of Arabic proverbs and idioms from three literary texts Banat AlRiyadh (Girls of AlRiyadh) by Rajaa Alsanea, Mawsim al-Hijrah ilâ al-Shamâl (Season of Migration to the North) and by Tayeb Saleh, and Suqut al-lmam (The Fall of the Imam) by Nawal El Saadawi) to be translated automatically by NMT systems in order to measure and evaluate the accuracy level of these software in particular. The researcher inserts texts containing a certain number of these expressions and analyze the obtained results after these systems translate the texts from Arabic into English. The performance of NMTs is evaluated in light of the seven standards of

textuality and human translation. Thus, if the translation meets the seven standards of textuality and the HT, it is deemed as a correct translation. After analyzing the samples, and making the required alignments with the human translation, it was found that Google Translator achieved the highest success rate, with a slight difference over Bing Translator, and then followed by Facebook Translator, the final analysis clearly shows that the syntactic structure of Arabic idiomatic expressions affects the effectiveness of Neural Machine Translation (NMT), as it was found that the NMT systems had achieved remarkable success in translating adjectival idiomatic expressions, while there is no significant value for the syntactic structure of Arabic proverbs. NMT still faces a number of difficulties when translating AFEs. The study also shows the tendency of (NMT) for providing the formal equivalence when translating Arabic idiomatic and proverbial expressions.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Translating involves comprehending the meaning of the SL text and successively producing an equivalent TL text. In other words, it is the act of communicating a similar SL message in the TL. The ST/SL refer to the text, as well as the language, which are translated from, whereas the TT/TL refer to the text, as well as the language, which are translated into, respectively.

In translation, if it is human and/or automated, a specific meaning of a given SL text should be conveyed to an equivalent TL meaning. According to Mundy (2001), translation involves ST-TT transmition the ST), considering the cultural, as well as the linguistic differences between languages and, therefore, it does not involve a simple word substitution from the source into the target culture or language. Many MT systems rely on a simple word-for-word replacement from a given language into equivalent expressions in the target language. Such replacement process from one language into another assists translators and supports their task. Therefore, if MT is used and maintained correctly, the product will be natural and accurate; otherwise it will result in a weak, horrible, and funny translation. Thus, to have a good acceptable translation, the SL style, syntactic structures, semantics, and cultural elements are equivalently maintained and rendered in translation.

In their attempt to define translation, theorists of translation have focused on the equivalence concept. Based on the provided definition by Catford (1965), translation involves replacing a SL textual material by an equivalent TL textual material. Therefore, equivalence has become a key element in translation theory. This term is explained according to Bowker and Ehgoetz (2007, p. 210) as “the

increasing demand for the translator with lacking competent translation professionals". This is one of the reasons for renewing the interest in machine translation (MT) along with other reasons such as the demand to penetrate new markets, the need to publish translated material, and the ongoing requirements to reduce the cost of translation. Previous studies on MT focused on computational and empirical research like statistical methods in MT and automatic evaluation of the translation output (refer to the proceedings of the MT Summit XI [Maegaard 2007] and the proceedings of TMI 2007 [Way and Gawronska 2007]). Accordingly, it is important for translators to keep abreast of developments in this area and actively contribute to recent advancements so that the translation community can meet the technological demands and provide well-informed feedback to system developers, end-users, and translation customers.

The reason behind the selection of translation systems like Bing Translator, Facebook Translation, and Google Translate is that these systems follow the Neural Machine Translation (NMT), which is described as the most accurate MT systems today. These translation systems are used by several bodies and international organizations, including the UN, the International Press Agency, and the World Health Organization (WHO), etc. Moreover, these translation systems are the most dominant programs to date despite some limitations and drawbacks like other translation systems and programs.

Regarding fixed expressions, Carter (1987) and Alexander (1978) employed this term of "fixed expressions" to encompass several types of phrasal lexemes, phraseological units, and lexical items, i.e., holistic units of more than two items, including grammatically incorrect collocations, frozen collocations, routine formulae, proverbs, sayings, idioms, as well as similes.

Idioms and proverbs are types of common expressions and sayings. These expressions have shades of meaning beyond what can be understood through their individual words. Idioms and proverbs or fixed expressions, as explained by Alexander (1978) and Carter (1987) display a given figurative meaning that is hard to be guessed from the whole meaning or even the literal meaning of its multiple units. In human communication, fixed expressions are essential as they enjoy cultural, as well as emotive connotations. These can help in facilitating the meaning at cultural and linguistic levels. The literal meaning of these fixed expressions is meaningless in the TL when the expressions are divided into their constituents, individual words. Therefore, the meaning can be almost impossible to understand unless you have learned or heard it before.

As a result, translating Arabic fixed expressions, that is, proverbs and idioms into English may not be an easy job because translation can be challenging for translators because of inherent differences, i.e., cultural and linguistic variations among languages (Baker, 1992, McMordiew, 1983). Problems resulting from misunderstanding or misrendering of Arabic proverbs and idioms into English worth examining and therefore, forms a key aspect of this study.

Difficulties in translating fixed expressions like proverbs and idioms are likely to include difficulties relating to ambiguity, structural and lexical differences between languages, and cultural differences (Shojaei, 2012). These problems are no doubt general problems, encountered by human and machine translation. However, the intensity or nature of difficulty and challenge might vary the need to address translation of the surface meaning as opposed to deep meaning and literal meaning as opposed to figurative meaning (Baker, 1992).

1.2 Statement of the Problem

Often, the credibility of translation and its effectiveness in conveying images of creativity from a given SL to the TL can be questioned in translation. Its faithfulness in conveying the content of the messages from one culture to another can be questionable, too. The interest and demand for MT have increased and, therefore, it is reasonable to assume that translators, who work in technical domains, are progressively required to interact with MT. However, research into this topic within translation studies is limited and insufficient. Despite all the accusations, translation maintains its status and imposes its presence through the interaction between different cultures and languages worldwide. Due to the direct openness to the cultures of the world, which is further enhanced by the advent of the Internet and automatic translation, MT has become an indispensable means of producing an easy, flexible, and speedy translation. MT, however, lacks perfection, credibility, and acceptance by users (Hutchins, 2003). Machine translation is specifically challenging in transferring sentences, syllables, as well as stereotypes, especially idioms and proverbs (Izwaini, 2006). This study, therefore, investigates the transference of proverbs and idioms, which are challenging in machine translation. Despite what has been mentioned about the improvements in machine translation, machines are said to fail still to capture sufficiently the writer's purpose to identify the context or the meaning to be transferred. Accordingly, the translation output is not satisfactory unless there is some amount of human translator intervention; the intervention of the translator takes the form of correcting, modifying, and adapting the text according to both linguistic and non-linguistic factors.

Different kinds of MT can be produced with the assistance of a human intervention called Human Computer Interaction (HCI) or without a human

intervention called Fully Machine Translation (FMT). These different kinds of MT might cause an inappropriate and vague translation because they, sometimes, produce literal translation, i.e., each word is separately translated, not considering how these words have been employed in a specific phrase or sentence (Sennrich et al., 2016). In other words, these systems cannot perform like expert translators, who can tackle and handle the text with great professionalism especially when we come to fixed expressions. As a result, this problematic aspect of translation can affect the users of these programs, which will lead to poorly translated texts. This is inconsistent with the primary mission of the process of translation.

MT has received a lot of criticism from scholars (Labutis, 2005; Vilar, Xu, D'Haro, & Ney 2006; Štefčík, 2015), as well as Arab scholars (Chalabi, 2001; Farghaly & Senellart, 2003; Al-Salman, 2004; Al-Wasiti, 2005; Izwaini, 2006). Scholars have also criticized the performance and the ability of MT in generating adequate translation between Arabic and English without human intervention. They mentioned that machine translation encounters many problems in producing meaningful and coherent translation between Arabic and English. It is, therefore, essential to investigate the syntactic, semantic, stylistic, and cultural problems pertaining to NMT systems, which are related to the translation of Arabic Fixed Expressions (AFEs). These problems might be considered as general problems for any translation like word order, cohesion, polysomy, homonomy, and the difference between the figurative and literal meaning. On the other hand, the problems might be considered as specific-oriented problems like problems of ambiguity, capturing the connotative meaning, and culture-bound expressions. Several problems might be challenging for NMT such as rare or low-frequency words, long sentences, and word alignment. (Koehn et al. 2017)

Recently, there have been claims by some leading companies in the field of translation, Bing IPA, Facebook, and Google that their systems, which depend on neural machine translation, can generate almost accurate machine translations as the human translator in a short time and at low cost. MT is almost a 'human-like' translation or it can be closer to the translation of the human translator (Wu et al., 2016). Such claims, which suggested that the Neural Machine Translation (NMT) system has achieved impressive results based on an automatic evaluation, are supported by many scholars among them Bahdanau et al., 2015; Sennrich et al., 2016; Bojar et al., 2016. In the Amidst of this debate between those who see the efficiency of the machine in translation and those who deny it, it has been found that the translation of fixed expressions using neural machine translation suffers from some of the problems that were referred to in the previous studies. The syntactic structure is affected when translated using neural machine translation from one language to another (Sennrich et al., 2016). The inability of the NMT to handle many colloquial terms (Moussallem et al., 2018). In addition, generating coherent long sentences remains a fundamental challenge for NMT (Koehn et al., 2017; Tinsley, 2018). Moreover, less used words or rare expressions are problematic for NMT systems (Koehn et al., 2017). The meaning of a given fixed expression can, therefore, be obtained by combining the constituent words of the expression. Therefore, if separated from each other, they lose their context and their real meaning, which constitutes a challenging issue in the NMT system, which often generates literal translation (Hamdi et al., 2013). Literal rendition of NMTs resulted in wrong equivalents, inappropriate additions and deletions, and transliteration for out-of-vocabulary (OOV) words (Sabtan et al., 2021).

1.3 Research Objectives

This study mainly aims to conduct a descriptive analysis of problematic aspects of machine translation when rendering Arabic Fixed Expressions (AFEs) such as idioms and proverbs into English. The study aims to highlight the problems that might arise when translating the AFEs including proverbs and idioms using NMT systems. Accordingly, this aim is translated into three specific objectives as the following:

1- To investigate the syntactic structure of the Arabic Fixed Expressions (AFE), which allows a high level of accuracy to be achieved in its translation using selected Neural Machine Translation (NMT) systems.

2- To identify the most efficient system among the selected Neural Machine Translation (NMT) systems that can render the intended meaning of the Arabic Fixed Expressions (AFE).

3- To investigate the problems that might arise when translating the Arabic Fixed Expressions (AFE) into English using Neural Machine Translation (NMT) systems.

1.4 Research Questions

In this study, these research questions are addressed:

1. What is the syntactic structure of the Arabic Fixed Expressions (AFE), which allows a high level of accuracy to be achieved in its translation using selected Neural Machine Translation (NMT) systems ?

2. What is the most efficient system among the selected Neural Machine Translation (NMT) systems that can render the intended meaning of the Arabic Fixed Expressions (AFE)?
3. What are the problems that might arise when translating the Arabic Fixed Expressions (AFE) into English using Neural Machine Translation (NMT) systems?

1.5 Significance of the Study

Previous studies investigated various problematic aspects of translation, which are encountered by translators. However, empirical studies that are related to the translation of the fixed expressions are limited and insufficient. This study is significant research because it is distinctive in comparison with the previously conducted studies in the literature. It is expected that the findings of this study contribute to translators, in general, and the students of translation, in particular, through providing the most appropriate translation methods, which can help in translating Arabic proverbs and idioms. This study is significant because it is one of a few related studies, which evaluates the efficiency of MT. This study primarily aims at enriching the literature about machine translation in the Arab world.

This study discusses the syntactic structure of the fixed expressions. This aspect has been so far neglected in previous studies, which focused on the linguistic, semantic, and cultural aspects of AFEs. Furthermore, the study applies the seven standards of textuality based on (De Beaugrande & Dressler, 1992) as an evaluation standard for the ability of the NMT systems to render the AFEs into English. This study applies Nida's equivalence theory (1964), i.e., formal and dynamic (functional) equivalence to investigate the ability of the NMT systems in capturing and rendering literal and figurative meanings of the AFEs into their English equivalents. The

findings of this study will represent a springboard for researchers, who are interested in investigating the problems and challenges pertaining to the transference of fixed expressions like idioms, proverbs, collocations, and religious terms using different systems of machine translation.

It is, therefore, expected that this study mainly contributes to translators, linguists, and translation specialists, as well as specialists in the field of artificial intelligence, and natural language processing, etc. This study is significant because it provides useful insights into this aspect of translation in an effort to improve the quality of translating Arabic fixed expressions into English using the NMT systems. This study provides accurate recognition procedures to assess the validity of the translation output.

1.6 Scope and Limitations of the Study

The scope of this study is limited because it is characterized as a uni-directional, text-oriented study from Arabic into English. Therefore, the focus is on Arabic fixed expressions, not English expressions. The MT systems, are evaluated, are limited as well. Three systems from a total of 8 systems are selected for the assessment. These systems support Arabic as a language pair. The three systems include Bing Translator, Facebook Translation, and Google Translate. The selected programs follow the neural machine translation system. Other types and architectures of MT such as rule-based machine translation, in additon to statistical machine translation are not included in the study. There are some justifications for selecting the corpora and the Neural Machine Translation (NMT) Systems are provided in details later on chapter 3.

Fixed expressions is a cover term used for several types of phrasal lexemes, phraseological units, and lexical items, i.e., holistic units of more than two items, including grammatically incorrect collocations, frozen collocations, routine formulae, proverbs, sayings, idioms, as well as similes. Moreover, this term in the current study is used to refer for proverbs and idioms only.

The study is also applicable to the partial side of the THTS since the medium is restricted as it is fully machine translation without human intervention and it is about written text not spoken. The area is also restricted in that it is a unidirectional study from Arabic into English but not vice versa. Rank is restricted because the study evaluates the AFEs at the sentence level, not at the level of single words. The text type and problem are also restricted that the study shows the problems such as ambiguity, word order, machine misunderstanding, the unfamiliarity of the AFE, and a lack of equivalence when dealing with literary texts (novels). Finally, time is restricted, since the time of conversion into NMT by the three selected systems is between (2016-2018).

The study is product-oriented as the AFEs are translated using three systems. Therefore, there are three products in addition to the standard translation, and this means four TTs for each ST. The study is also function-oriented as it deals with proverbial and idiomatic expressions that are related to culture and society. It is also process-oriented because the current study focuses on how the NMT systems process the data. The study is also in harmony with the second and third sub-branches of the applied translation studies. The NMT systems, which are Bing translator, Facebook translation, and Google, represent the second branch of applied TS. The evaluation of the NMT's products and quality represents the third branch.

1.6 Definitions of Key Terms

Operational definitions of key terms are provided in this section. Further elaboration of these terms is provided in Chapter 2 and Chapter 3.

Translation: It involves transferring a given SL text into its equivalent TL text. Translation involves the process, the translation methods, as well as the strategies implemented in conveying the SL message into a corresponding TL message (Ghazala, 2003).

Machine Translation: It involves producing a given TT in a given language from another text in another language by using computer procedures (Hutchins, 1988).

Neural Machine Translation (NMT): NMT involves translation automation, which utilizes learning models to produce natural and accurate translation compared to traditional statistical, as well as rule-based translation algorithms (Yonghui Wu, 2016).

Equivalence: It involves the resemblance between a certain word (phrase or expression) in a given language with the corresponding translation in a different language, whereby a similar situation is replicated by utilizing different wording (Vinay & Darbelnet, 1958)

Translatability: It is the quality or property of being translatable; the ability to be translated. Hermans (2009) stated that the ongoing debate over “translatability” is mainly about the possibility of translation across languages, i.e., how translatable a text is and to what extent.

Untranslatability: It involves that some SL utterances do not have corresponding words or phrases in the target language. Therefore, it involves no translational equivalence when rendered from one language into another (Collins English Dictionary).

Seven Standards of Textuality: These standards encompass coherence, cohesion acceptability, intentionality, informativity, intertextuality, and situationality, which are introduced by De Beaugrande and Dressler (1992) to designate that a given text delivers a specific communicative purpose.

Fixed Expression: It is a term used to refer for various types of phraseological units, phrasal lexemes, or multiword lexical items; these represent holistic units, including ill-formed collocations, frozen collocations, proverbs, sayings, routine formulae, and idioms. (Carter, 1987).

Proverbs: A traditionally conversational genre, which has a more general meaning with an associated figurative meaning (Norrick, 1985)

Idioms: These involve a set of words in a certain sequence with an entire different meaning from the words that constitute the idiom (Crystal, 2008).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Translation, in general, can be carried out either by a human, a machine or sometimes it can be performed through a collaboration of a human and a machine. Human translation can be referred to as the process of transferring a specific text from a given language into a different language by a human (Hutchins, 2003). Machine Translation (MT) can be defined in terms of using a machine to carry out the translation task and convert a given text or speech in one specific Source Language (SL) into a different Target Language (TL). Machine Translation (MT) is the translation of words, phrases, or texts from a given language into another diffrent language by using the computer software. MT is one branch of the computational linguistics, which involves the utilization of computer software in translating a text from a given language into a different one (Uszkoriet, 2000). It combines techniques and concepts from Computer Science, Linguistics, Artificial Intelligence, translation theories, statistics for the automation of translation, and Natural Language Processing. In translation, whether it is human and/or automated translation, the meaning of a given SL text should be transferred into an equivalent TL meaning. However, it is not a simple process; it is complicated because it is not a word-for-word transferrence between SL and TL. Translators must understand the meaning of the SL words and how these words or phrases may affcet the overall context. Translators, therefore, should have ample experience in semantics, as well as expertise in syntax and grammar of SL and TL languages. Challenges in human, as well as machine translation may involve that no identical translations can be produced by translators. Machine translation, on the other hand, may encounter difficulties in translating cultural and contextual elements due to

differences between languages and their ambiguities. This chapter reviews the related studies in the literature about MT, its types and models, the quality of MT, human and automatic evaluations of MT, theories of equivalence, and the implemented models in translating proverbs and idiomatic expressions.

2.2 Historical Background of MT

The idea behind the machine translation started in the eighteenth century. However, the real history of automatic translation began in the 1950s after World War II, through which there were rapid developments in the automatic processing of language as a necessity in order to analyze the codes of communication among armies. Hutchins (1986) stated that the dream of the MT started in the seventeenth century, and has become a reality in the late twentieth century. The history of MT has been widely investigated by many scholars (Nagao, 1984; Lehrberger & Bourbeau, 1988; Hutchins, 1988, 1993; Hutchins & Somers, 1992; Arnold et al., 1994).

There are many classifications of the MT history depending on the events and the developments that are related to the machine. The researcher investigated studies that were conducted in this regard and opted to classify MT chronologically into three stages. The first stage represents the beginning of MT. The second stage is the age of Genesis and formation. The third stage is the age of the Internet and professionality.

The first stage, which represents the beginning of MT, lasted around a decade in which there were some attempts and ideas on the use of computers in translation. Among these ideas, Warren Weaver (1949), who proposed the first idea to use the computer in translation by adopting the term ‘computer translation’. In the 1950s, there was a collaborative work between Georgetown University (USA) and IBM to translate some sentences from Russian into English. That system was composed of about 250 words and 6 grammar rules. The first symposium about MT was held in

1952. In 1954, a group of researchers from Georgetown University in cooperation with IBM developed the first automatic translator, in which more than sixty (60) Russian sentences were translated into English. In the same year, Victor Yngve published the first journal on MT entitled 'Mechanical translation devoted to the translation of languages with the aid of machines'.

The second stage is the age of Genesis and formation. This age lasted around three decades, between the 1960s and the 1990s. It was a long era and during which, there were many advantages, as well as drawbacks. During that time, computational linguistics was born. The International Conference on Machine Translation and Applied Languages was held in 1961 with the participation of many linguists and computer scientists, who were involved in translation including Paul Garvin, Sydney M. Lamb, Kenneth E. Harper, Charles Hockett, Martin Kay, and Bernard Vauquois. In 1964, ALPAC (Automatic Language Processing Advisory Committee) was formed to explore the prospects of machine translation. The committee after two years published its report that machine translation is time and money consuming, which resulted in a negative impact on MT for many years. After such a drawback, specifically in 1970, there was a turning point made by Russian researchers, who developed REVERSO and SYSTRAN. This progress was followed by the creation of the WEATHER system by the University of Montreal for the machine translation of weather forecasts and ATLAS by the Japanese firm FUJITSU to translate from Korean to Japanese and vice versa in 1976 and 1978, respectively. At the end of this era, there were remarkable steps by the Japanese represented by developing the automatic translator DUET (English - Japanese) by Sharp in 1982. NEC developed Honyaku Adaptor II in 1983. It is a translation system, which is based on Interlingua. In 1986, PENSEE was developed by a Japanese manufacturer of telecommunications, which is a Japanese-

English translator based on rules. In the same year, Hitachi developed a Japanese-English Computer-Aided Translation System. Hutchins (2003) stated that the best-known project of the 1980s was the Eurotra project of the European communities. It aimed to construct an advanced multilingual transfer system for translation among all the community languages.

The third stage is the Internet and professionality age. This age started since Bernard Lee invented the World Wide Web in 1990 and continued until today. Machine translation has been significantly grown since then as a result of open access to the Internet in the 1990s. In 1993, the C-STAR was developed. It is a machine translation project in the field of tourism (dialogue client travel agent) through videoconference. This project was followed by introducing C-STAR I in the same year. This system tackles three languages (English, German, and Japanese). In 1998, Softissimo company introduced the translator REVERSO. In 2000, the ALPH system was developed by the Japanese laboratory ATR. This Japanese-English and Chinese-English translator is based on examples. In 2005, the first website for automatic translation (Google) was introduced. After that, different types and models of MT systems became popular and well-known including the hybrid machine translation system, Example-based, Rule-based Machine Translation, and Neural Machine Translation (SMT, EBMT, RBMT, and NMT, respectively). Hutchins (2014) states in this regard that this age witnessed the domination of corpus-based approaches, translation memories, example-based MT, and particularly statistical MT. However, there has been much greater attention to various evaluation methods. The applications, as well as the use of MT, have been widely implemented through the access to and use of MT and resources on the Internet.

MT programs and systems usually help translators in producing a translation quickly. Therefore, the majority of translators these days depend on such programs to translate. In this regard, Garje and Kharate (2013) published a survey regarding the tendency of Internet users in using MT. They found that 23% of the Internet users used machine translation in 2008 and 40% of the users considered using it. Moreover, 30% of the professionals used machine translation, and 18% of them performed proofreading in 2009. In 2010, the percentages increased steadily as statistics showed that 28% of Internet users used machine translation and 50% of them planned to use it.

2.3 MT in the Arab World

Arabic is spoken in the Middle East region, as well as South Africa, and in fast-growing markets, it is the most used language for more than 420 million speakers according to the latest statistics (Eton Institute, 2017). In the UN, Arabic is one of six official languages used officially, and in terms of the native speakers number, Arabic is one of top five languages in the world with Mandarin Chinese followed by Hindi, then Spanish, and English, and finally Arabic. It is No. 7 language in terms of the Web use with 3.3% of Internet content, whereas Chinese and English cover over half of the Internet content, whereby English is used by 26.8% Internet users and 24.2% use Chinese (Aldeek, 2013). These statistical results showed the importance of Arabic. Therefore, there is an increasing interest in Arabic-English-Arabic translation projects and to many languages as well.

Arabic is one of the tested languages during first attempts in the field of MT, specifically in the US as the Americans are interested in the events that occur in Arab countries. One of the most successful American projects, which is related to Arabic MT into English is Global Autonomous Language Exploitation (GALE) to translate Arabic official news into English. This project has been sponsored by the Defense

Advanced Research Projects Agency (DARPA). DARPA has implemented many other MT projects in Arabic to bridge language barriers like the Translation System for Tactical Use (TRANSTAC). This program aims to achieve two-way communication for its users. TRANSTAC is particularly designed for translating short phrases. However, TRANSTAC is replaced by another program called Broad Operational Language Translation (BOLT). This program used new techniques. BOLT can translate textual, voice, as well as in-person communication. DARPA claimed that the BOLT program aims at processing informal speech of a foreign language, as well as texts, dealing with incorrect and incomplete syntax, handling colloquialism, as well as idiomatic speech. It also aims at resolving references, as well as correlating co-references. BOLT translates all media types with the use of Mandarin, as well as multiple Arabic dialects.

The Arabic Conference for Natural Language Processing concluded that studies that investigate the automatic processing of the written Arabic language started in the 1970s (Boualem, M, cited in Zughoul, M 2005). At first, studies focused on vocabulary, as well as morphology. After globalization, however, studies included more general aspects of Arabic language processing including syntax, as well as machine translation.

Arab countries have implemented machine translation relatively late. Limited attempts were exerted to enhance Arabic MT systems. Such attempts were carried out by several institutions like ATA. This leading company was established in London in 1992. It focused on the field of Arabic language software, especially automatic translation from Arabic to English and vice versa. ATA provided two applications to translate from English into Arabic, Al-wafi, and Al-mutarjim. Sakhr Media Foundation, on the other hand, is another company in Egypt. It has made remarkable

contributions, particularly, in the area of linguistic industries. This company recruited around 100 professionals in information technology to improve software applications for Arabic. It produces automatic programs to translate from English into Arabic like "Almisbar and Ajeeb".

However, the programs that were produced by Arab, as well as foreign institutions focus mostly on translation from English into other languages and translation into English. Therefore, programs from Arabic to other languages like French are scarce. MT programs in the Arab World are limited within the second generation boundaries and these programs do not fulfill the third generation needs in different contexts between the Arabic language and other languages. Such programs failed, according to the Middle East Newspaper (2002), due to their weak performance in translating literary texts specifically. These programs were not subject to the required developments as they were not updated.

2.4 Types of MT

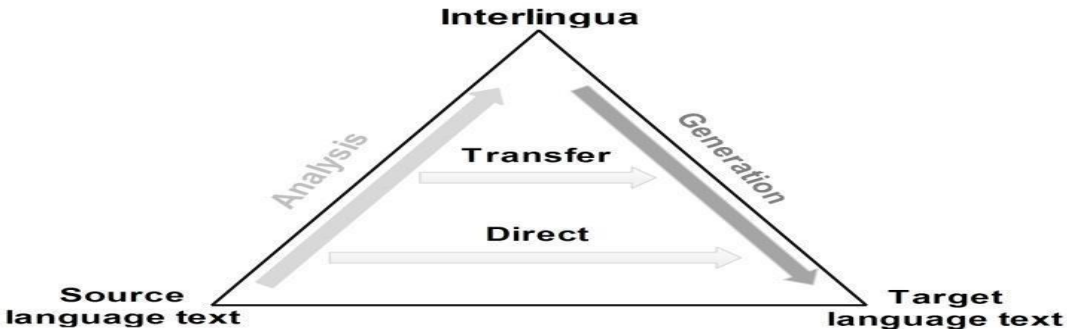
There are various approaches and categories for machine translation. Some scholars have classified MT according to the target language and others have classified MT according to the design system or human intervention ratio. This section reviews the MT major classifications.

Hutchins (1994) categorized machine translation into three categories: human-aided MT, machine-aided MT, and computer-aided MT based on aiding type. Based on input or output edition, machine translation is two types, including pre-edited, as well as post-edited. Based on the target language, machine translation is either bilingual or multilingual, as well as interlingua, direct translation, and transfer based on the method of translation.

Hutchins's approach is close to the approach of Vauquois (1968) in the classification of the MT into three categories according to their design: systems based on direct and interlingua-based transfers. A general way to implement these three approaches is through the well-known "Vauquois Triangle" as shown in Figure 2.1. The triangle shows a comparison between the intermediate representation, with the automatic translation of Interlingua in the upper part of the triangle, followed by direct and based translation on the transfer. It represents a growing level of depth that is required for both analysis and generation as the translator transfers from a direct approach toward a transfer approach, then to an interlingua approach. This gives an idea of the decreasing amount of knowledge of the required transfer as we ascend this triangle. From the big transfer amount at the direct level, each word involves knowledge transfer through the transfer level, which requires the rules of transfer only for the analysis tree. The interlingua level symbolizes the independent conceptual from the ST/TT language structure.

Figure 2.1

Vauquois Triangle



Note: Figure 2.1 is adapted from (Dorr, 2004)

Slocum (1985) provided three categories of MT according to the percentage of human intervention in the process of translation. The first category is the full machine translation (FMT); it is performed without human intervention. The second category is machine-assisted translation (MAT), also called 'machine-aided translation'. It is a cooperation between a human and a machine to produce the TT. The third category is the Terminology Data Bank (TDB), which provides access to technical terminology.

According to Strauss (1998), machine translation can be either bilingual or multilingual. In bilingual translation, the system involves two languages, i.e, SL and TL. If the translation is from an SL into a TL, it is unidirectional, otherwise, it is bidirectional, and multilingual translation includes more than two languages and by default, they are supposed to be bidirectional.

Homiedan (1998) stated four types of machine translation, including machine translation for watchers, machine translation for revisers, machine translation for translators, and machine translation for authors; the four types completely differ based on the target group to which they are assigned. MT-W serves the readers, who seek information written in foeign languages regardless of the translation quality. This type existed because there was a need for translating military information. It depends on dictionary meaning, not on linguistics. MT-R produces raw translations, which are almost similar to human translation. MT-T assists the human translator in translating using online dictionaries, glossaries, and thesaurus. This type is incorporated in translation workstations, as well as PC-based translation equipment. MT-A assists authors, who translate to a given foreign language and those, who perform translation with the help of a system to disambiguate utterances so that an adequate translation is produced without revision.

Tripath and Sarkel (2010) emphasized two levels of translating sentences with the use of a system of machine translation, i.e., to meta-phrase and to paraphrase. To metaphrase means word-by-word translation, which is related to formal equivalence in the TL. The semantics of the SL sentence can be, therefore, lost in translation, which constitutes a major drawback in this method. To paraphrase means dealing with the text that contains the main ideas of the source language. The difference is in the syntactic word order, which is related to dynamic equivalence.

Chéragui (2012) explained two basic MT types: the linguistic machine translation, as well as the computational macine translation. As for the linguistic machine translation, 3 different approaches exist: a direct approach, a transfer-based approach, in addition to an interlingua approach.

According to Antony (2013), machine translation in India falls into 3 kinds based on Natural language Processing (NLP), including Human-Aided Machine Translation (HAMT), Fully-Machine Translation (FMT), and Machine-Aided Human Translation (MAHT). There are also 7 types under FMT, including statistical-based, rule-based, hybrid-based, knowledge-based, example-based, as well as principle-based, in addition to the online interactive methods. Almost all these Indian MT projects are based on hybrid and statistical systems.

Three approaches to building machine translation systems exist. They are the knowledge-driven approach (i.e., Rule-based Machine Translation RBMT), the Data-driven Machine Translation (DDMT) approach (i.e., machine translation based on corpus), and the hybrid machine translation. This approach incorporates the benefits of the first and second approaches (Kituku et. al, 2016).

According to Singh et al. (2017), MT incorporates, corpus-based machine translation, rule-based machine translation, neural machine translation, as well as

hybrid machine translation. Machine translation based on rules is also known as knowledge-based machine translation. As a basis for the translation process, they concentrate on linguistics, as well as rules and make use of manually generated rules. For common words, it uses a combination of linguistic and grammatical rules plus dictionaries. The rule-based approach is the first developed method of MT (Antony, 2013). To expand on the rules, it is a mixture of grammatical, bilingual, or multilingual lexical rules and software programmes. Nair & David (2012) stated that transfer-based machine translation and interlingua-based machine translation are the two primary approaches to rule-based machine translation. It is now being replaced progressively by corpus-based approaches. Corpus-based machine translation is referred to as machine translation based on information. As the basis for the translation process, corpus-Based is based on an aligned bilingual corpus, not considering language rules. It translates instead by analysing vast quantities of data for each language pair (Nair & David, 2012). Based on examples, the two primary methods of corpus machine translation involve statistical machine translation, as well as machine translation. Hadiwinoto (2017) sees that machine translation of statistics relies on large data sets of phrases from one human language to another human language. This method can be regarded as a random operation. It involves approaches like tree-to-chain, chain-to-chain, and tree-to-tree mapping. The key principle behind these methods is that translation is carried out by parallel corpus automatically. To conduct the translation, EBMT relies primarily on analogy. The latest approach to machines that allow the algorithm learn to translate through a broad neural network is Neural Machine Translation (i.e., multiple processing devices such as the human brain). NMT employs neural networks, which contain nodes that are conceptually modelled much like a human brain, to produce better translation output. These nodes

can hold single words, sentences, or longer segments and, according to bilingual texts that are used in training the system, can refer to each other in a network of complicated relationships.(Hadiwinoto, 2017)

NMT systems are continually evolving so that the most suitable output is given, which requires significant processing power. That is why, recently, the NMT solution has become feasible. Hybrid Machine Translation is a mixture of RBMT and SMT. The text is rendered first by the RBMT engine. Then, the SMT engine carries out translation. It corrects mistakes. The RBMT engine does not, however, conduct the translation of a document. Rather, by adding metadata, for example, noun/verb/adjective, present/past tense, and so on, it supports the SMT engine.

2.5 Neural Machine Translation

As a system of language translation automation, neural machine translation can be described. In order to generate more precise and natural translation than standard, statistical, and rule-based translation algorithms, it uses deep learning models (Amazon, 2017). This technique uses a broad artificial neural network to expect a particular sequence of words to be possible, usually modelling whole sentences in a single integrated model. Neural Machine Translation is the newest development in machine translation (NMT). Various MT hypotheses, as well as practises, have appeared in recent mathematical models, including commercial rule-based systems. There are, however, differences in standards of what MT needs to accomplish and what MT can accomplish The neural approach (NMT) has recently emerged as a new paradigm in MT systems that has raised interest in academia and industry by outperforming phrase-based statistical systems (PBSMT) based on outstanding results in automatic evaluation. Therefore, NMT has been introduced by different translation

systems such as Google, Facebook, and Bing (Bahdanau et al., 2015; Sennrich et al., 2016; Bojar et al., 2016).

MT is almost regarded as a “human-like” translation because it is very much close to the translation of the human translator (Wu et al., 2016). Announcements such as Google 2016 preceded these claims, stating that the new system (GNMT) achieved relative precision such as human translation. These claims were made because of changes observed by the MT. The neural machine translation system is a Google Neural Machine Translation (GNMT) system. It was developed and launched in November 2016 by Google. Via a combination of the best of recent NMT models, Google researchers have blended various engines: convolutional neural networks (CNN), recurrent neural networks (RNN), as well as the model of own self-attentional transformer. An artificial neural network is utilized to enhance accuracy and fluency of Google Translate (Johnson, 2017).

Facebook revealed in May 2017 that machine learning researchers have built a neural network that translates very quickly, almost nine times faster and more precise than current systems that use a traditional method for translating text (Verger, 2017). The number of Facebook users in 2017 was two billion, based on Cornell University figures in 2018, and they used to generate 4.5 billion translations in one day. In the first quarter of 2018, the number of active Facebook users was 2,27 billion per month, making it the most powerful social network (www.statista.com).

Bing started NMT in 2018 and the latest version of Bing neural machine translation did not only provide translation, but in addition to a bilingual dictionary to find terms for alternate translations, NMT included new features like transliteration. It contains numerous examples as well. Eleven languages provided by the Microsoft Translator Speech API have been added. These are Mandarin, Arabic, English,