



Functional Capabilities Of Modern Machine Translation Systems And Features Of Their Application In Specialized Fields

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ABSTRACT

This article provides a scientific and theoretical analysis of the development, functional capabilities, practical effectiveness, and role of machine translation (MT) technologies in the professional translation process. The advantages of machine translation in ensuring speed, terminological consistency, economic efficiency, and translation accuracy are examined comparatively with human translation. Based on the experience of PAHO, the Foreign Technology Division of the U.S. Air Force, and the METEO system, the effectiveness of MT in translating medical, military-technical, and meteorological texts is considered. In addition, the communicative significance of MT technologies in the automatic translation of web pages and multilingual information resources in the Internet environment is substantiated.

KEYWORDS: Machine translation, automatic translation, translation technologies, human translation, terminological consistency, translation quality, translation accuracy, economic efficiency, subject domain, specialized translation, PAHO, METEO system, web-page translation, multilingual communication.

INTRODUCTION

Regardless of whether the translation process is carried out by a human or through an automated system, its primary task is to fully understand and interpret the meaning embodied in the source-language text and to reproduce it in the target language in a semantically and functionally adequate form. Although this process may appear simple at first glance, in practice it encompasses a complex set of linguistic, semantic, pragmatic, and cognitive operations.

The human translation process primarily involves decoding the semantic structure of the source text, that is, identifying the information, communicative intention, and semantic relations contained in it. At the next stage, the identified meaning is re-encoded in accordance with the lexical-grammatical, syntactic, semantic, and stylistic norms of the target language. Thus, translation is manifested not as a simple replacement of linguistic units from one language with those of another, but as a process of transforming meaning from one linguocultural system into another linguocultural system.

Behind the relatively simple external appearance of this process lies complex cognitive activity. In order to fully decode the meaning of the source text, the translator is required to comprehensively interpret and analyse all of its linguistic and extralinguistic features. This requires a thorough command of the grammatical system, semantic features, syntactic structure, phraseological and idiomatic units, stylistic devices, and discourse patterns of the source language. At the same time, the translator must possess sufficient knowledge of the

national and cultural characteristics, communicative norms, social experience, and conceptual worldview of the speakers of the source language.

The process of adequately re-encoding the meaning of the source text in the target language also requires the translator to have a thorough knowledge of the linguistic and linguocultural system of the target language. In this case, identifying the lexical equivalent of a translation unit alone is insufficient; it is important to reproduce its contextual meaning, pragmatic function, stylistic characteristics, and communicative effect in the target language as fully as possible. Thus, high-quality translation is based on ensuring not only semantic equivalence but also functional-pragmatic adequacy.

The complex, multilayered, and dynamic nature of natural languages significantly complicates the process of machine translation. In particular, the polysemous nature of many lexical units, the possibility of different semantic interpretations of a single syntactic construction, the existence of context-dependent meanings, and the absence of direct equivalents in one language for grammatical categories and relations existing in another create certain linguistic problems for automatic translation systems.

Literature Review

In the mid-1930s, a completely new scientific concept aimed at automating the translation process with the help of technical means began to emerge. The scientific views of the French-Armenian scholar Georges Artsrouni and the Russian researcher Petr Troyanskii played a particularly important role in the development of this idea. They proposed the possibility of using machines as technological tools for carrying out translation activities. In particular, P. Troyanskii not only proposed the concept of creating an “automated bilingual dictionary” but also substantiated the necessity of developing a scheme based on the special coding of interlingual grammatical relations and functions. The fact that these scientific ideas were formulated before the creation of the first electronic computers can be regarded as an important methodological development in the history of machine translation.

An important stage in the practical and scientific development of these theoretical ideas dates back to 1946. It was during this period that mathematician Warren Weaver further developed the initial conceptual foundations of machine translation and scientifically expanded the prospects for automating translation processes. As a result of subsequent research, several functional forms of machine translation emerged. These included Machine-Assisted Human Translation (MAHT), Computer-Assisted Translation (CAT), Human-Assisted Machine Translation (HAMT), and Fully Automatic Machine Translation (FAMT) [1]; [2]. These technologies differ from one another in terms of the degree of human and machine involvement in the translation process, their functional tasks, and the scope of automation.

Some types of machine translation are used as auxiliary tools supporting the work of professional translators and serve to increase the speed and efficiency of the translation process. Other systems make it possible to obtain a finished translation product within a short period of time without direct human participation or with minimal intervention. Although the results of such automatic translation are distinguished by their speed, their linguistic, semantic, and pragmatic quality may be lower than that of professional human translation. From this perspective, within the framework of the present study, Fully Automatic Machine Translation (FAMT) is considered the primary object of research.

Scientific and practical attitudes toward machine translation have historically developed in two opposing directions—positive and negative perspectives. Therefore, in objectively assessing the capabilities of machine translation, it is important to analyse the scientific foundations, evidence, and methodological positions of both approaches. In this regard, it is appropriate to interpret machine translation not as a direct competitor to the human translator, but as a specialized automated system designed to perform specific communicative, linguistic, and technological tasks.

In the history of machine translation development, there have also been periods when the prospects of this technology were assessed extremely negatively. In particular, the report prepared in 1966 by ALPAC—the Automatic Language Processing Advisory Committee—had a significant impact on the development of scientific research in the field of machine translation. The report advanced the conclusion that the possibility of creating practically useful machine translation in the near future was very low. This position is regarded as one of the important factors that led to a decline in the funding and pace of development of machine translation research.

The semantic and lexical errors observed in early machine translation systems also contributed to the strengthening of critical attitudes toward this technology. For example, the automatic translation of the Russian proverb meaning “the mind is ready, but the body is weak” as “the vodka is good, but the meat is spoiled” demonstrates the incorrect identification of context-dependent meanings of lexical units. Similarly, some expressions were transformed during automatic translation into semantically illogical units such as “invisible fool,” while the concept “hydraulic ram” was incorrectly interpreted as “water goats.” The rendering of the headline meaning “The company recorded significant growth” as “The guests mailed a large growth” also demonstrates the existence of serious problems related to lexical-semantic disambiguation in machine translation.

Researchers distinguish two main problematic aspects in the interaction between machines and natural language. The first problem is related to contextual, pragmatic, and linguocultural factors. Computer systems are not capable of fully perceiving contextual and pragmatic information that humans intuitively understand in the process of communicative activity. A person interprets the meaning of a particular speech unit not only on the basis of its lexical meaning, but also on the basis of the communicative situation, the speaker’s intention, social relations, prior knowledge, and cultural context. In machine translation systems, however, the comprehensive modelling of these extralinguistic factors and their integration into the translation process constitute a complex linguistic-computational problem.

In addition, linguocultural differences between languages also have a significant impact on the quality of automatic translation. Certain linguistic units, phraseological expressions, idiomatic constructions, realia, metaphors, and cultural connotations are closely connected with the historical experience and national worldview of a particular linguocultural community. Therefore, translating them into another language on the basis of mechanical or formal equivalence may lead to semantic losses, pragmatic inconsistencies, and distortion of communicative meaning.

The second problem is directly related to the multifunctional nature of language. Human language is not merely a means of transmitting information or expressing the meaning of objects and phenomena. Language simultaneously performs communicative, emotive,

expressive, pragmatic, aesthetic, socio-integrative, and a number of other functions. For example, people also use language to create humour, establish social solidarity, strengthen interpersonal relationships, and express feelings and emotional states. In such communicative situations, the transmission of precise factual information may not be the primary objective; rather, the pragmatic effect, emotional-expressive character, or aesthetic function of speech may take priority.

In particular, the translation of dramatic works, poetry, advertising texts, journalistic and newspaper materials, and song lyrics constitutes a complex linguistic and translation-related task. Such texts contain not only denotative meaning but also connotative meaning, imagery, metaphorical expression, stylistic colouring, rhythm, wordplay, intertextuality, and linguocultural components. Adequately reproducing these features by means of another language requires a high level of linguistic, cultural, and interpretative competence even from professional translators. Therefore, traditional machine translation systems face significant limitations in producing high-quality translations while fully preserving the semantic-pragmatic, stylistic, and aesthetic features of such texts.

Research Discussion

Although machine translation (MT) systems have been subject to numerous critical assessments, there are also scientific views that acknowledge the effectiveness and practical significance of this technology. According to Newton, the limited ability of computer systems to independently acquire, understand, and logically apply knowledge about the real world in the same way as humans cannot be considered sufficient grounds for regarding machine translation as ineffective as a practical tool [7]. Although it may not be appropriate to use MT systems equally and without limitation in all situations, they possess certain advantages in the translation process. In particular, machine translation is characterized by its ability to use terminological units consistently, ensure relative stability in interpreting textual meaning, avoid omitting individual paragraphs or pages, and, in certain cases, remain free from subjective or incorrect assumptions that may occur even among experienced professional translators.

Gross also supports Newton's views, noting that machine translation systems can compete with human translators in such important indicators as speed, economic efficiency, and accuracy. According to the researcher, an MT system can achieve high efficiency when adapted to operate within a specific subject area or specialized terminological domain [8]. Such specialization is explained as a process similar to the way a professional translator working in a particular field achieves high performance through domain-specific knowledge and experience. At the same time, Gross emphasizes that some negative attitudes toward machine translation may be associated not so much with the actual functional shortcomings of the technology as with people's general caution or psychological anxiety toward machines and new technologies.

From this perspective, the question of what empirical evidence can be used to demonstrate the effectiveness of machine translation as a successful technology emerges as an important research issue. One of the most reliable ways to substantiate such effectiveness is to examine the results of practical projects in which MT systems have been introduced into real professional activities. One such practical experience is the automated English-to-Spanish translation system used by the Pan American Health Organization (PAHO). This machine



translation system was specifically developed for processing and translating medical information and was used as one of the principal technological tools in the organization's translation activities. According to Vasconcellos and Bostad, PAHO conducted a special study aimed at comparatively evaluating the quality indicators of machine translation and human translation, and the results demonstrated the high effectiveness of MT according to certain criteria.

Conclusion

In general, another important practical experience involving the use of machine translation tools is associated with the activities of the Foreign Technology Division (FTD) of the U.S. Air Force. Within this system, a text machine-translated from Russian into English and partially post-edited was evaluated by independent experts [8]; [9]. According to the comparative analysis, although the human translation was more fluent stylistically and syntactically, cases involving the use of inappropriate or incorrect terminological units occurred more frequently than in the machine translation. For this reason, the experts relied more heavily on the machine translation as the primary source of information, while the human translation was used mainly as an additional comparative source. This result demonstrates the ability of MT systems to ensure terminological consistency and accuracy in the translation of texts based on specialized terminology.

According to Somers's research, one of the most successful practical projects in the field of machine translation is the METEO system associated with the automatic generation of French-language weather forecasts [11]. This system was capable of automatically translating more than 30,000 words of meteorological information from English into French each day. The economic cost of translation per word was less than 0.5 Canadian cents, while translation accuracy reached 95 percent. The effectiveness of the METEO system is particularly evident in processing regularly recurring, standardized, and terminologically restricted texts. Since the continuous performance of such monotonous and large-scale translation tasks by human translators is labour-intensive, their automation is regarded as one of the practical advantages of MT.

Another promising field of application for machine translation is associated with information retrieval on the Internet and the automatic translation of web-page content. The increase in the number of Internet users and their belonging to different linguocultural environments, social experiences, and communicative needs has significantly increased the demand for multilingual digital communication. As a result, differences between languages have begun to function as a certain linguistic barrier in the process of global information exchange and communicative interaction. In order to reduce this communicative problem and expand access to electronic information resources in different languages, search engines such as Google, AltaVista, and Yahoo integrated machine translation services into their platforms. Thus, MT technologies have developed into an important technological tool that facilitates interlingual information exchange in the Internet environment, ensures the linguistic accessibility of electronic resources, and increases the effectiveness of multilingual communication.

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