Comparative Analysis of the Effectiveness of AI and Professional Linguistic Translation

Azizov Dilshat [1]

[1]Kazakh Ablai Khan University of International Relations and World Languages, Almaty, Kazakhstan

Abstract— *This article presents a comparative analysis of the effectiveness of translation using artificial intelligence (AI) and professional linguistic approaches. The advantages and disadvantages of both methods are analyzed, as well as their applicability in various contexts. A practical comparison is provided between the translation of general and specialized texts by a linguist and a neural network. It is emphasized that, despite the achievements of AI, the role of the linguist remains crucial, especially when cultural nuances, contextual, and idiomatic details need to be considered. Special attention is given to translation in specialized fields such as medicine and law, where accuracy and context are of utmost importance.*

Keywords—*Artificial intelligence (AI), professional translation, machine translation (MT), linguistics, cultural nuances, context.*

I. INTRODUCTION

Traditional linguistic translation by professional translators is still the only way to achieve textual accuracy and nuance. However, technology and new tool development, such as artificial intelligence (AI), raise the need for reconsidering the approaches: modern translation systems, including neural networks, are an alternative to traditional methods and promise large increases in speed and decreases in cost. Nevertheless, the most topical questions are about how precisely AI performs its duties and whether it can support cultural and contextual aspects of a text.

The research is directed at comparing the efficiency of translation with AI assistance to that performed by professional linguists. It also covers aspects of translation accuracy, speed of text processing, and economic efficiency for each method. Particular attention is given to the analysis of limitations which AI faces in the process of translation, and a search for advantages and disadvantages of both approaches.

II. MAIN PART. PROFESSIONAL LINGUISTIC TRANSLATION: KEY FEATURES AND STAGES OF WORK

Professional linguistic translation is a multi-factor and complex process where the translator not only converts text from one language into another but also considers its cultural context, stylistic features, and the author's intention [1]. It calls for an enormous amount of linguistic competence, knowledge of the culture and traditions of both language groups, and the ability to interpret the text. In contrast with automated translation systems, which often lean on mechanical word substitution, the professional translator aspires to secure the integral transmission of meaning while maintaining the same style and emotional tone found in the original text. These characteristics make professional translation highly valued in legal, scientific, literary, and technical fields [2]. The process of professional translation can be conditionally divided into several key stages (fig. 1).

Fig. 1. Stages of professional translation.

First, the translator analyzes the source text at this stage, looking into its structure, its content, and the context; then, he will make his researches on the subject, particular terminology, and on the target audience. Translation at this step means the very process of the text transfer from one language into another and requests the profound grammatical and stylistic knowledge of both languages. While it requires maintaining lexical accuracy, it is also of great importance for a translator to ensure that the flow of the text goes naturally according to the language of the target translation. Further steps include refinement in translation and improvement within editing and proofreading, where a check against the original for consistency and correction of all possible errors takes place. At the end, after the completed text is obtained, the translator does a final review to ensure that the translation meets all the requirements and quality standards.

III. ARTIFICIAL INTELLIGENCE IN TRANSLATION: HISTORY OF DEVELOPMENT AND KEY TECHNOLOGIES

In sum, integration of AI into translation truly revolutionized this field within the last decades. Generally, the history of the usage of modern technologies in translation began with the very emergence of the first machine translation (MT) systems in the mid-20th century. Early attempts at the development of such systems were based on principles that utilized predefined lexical and grammatical rules and dictionaries for translating text from one language to another. Systems such as the Georgetown-IBM experiment in 1954 were a milestone for those times but had the limitation of handling lexical nuances, idiomatic expressions, and context, making them ineffective for complex translations [3].

The quality of MT improved considerably with the advent of statistical machine translation (SMT) in the 1990s. SMT systems analyzed large volumes of bilingual texts for

statistical patterns and relationships between words and phrases in different languages. This data-driven approach allowed for more accurate and flexible translations than rule-based methods. Systems like Google Translate and Microsoft Translator, which are popular today, initially used SMT, but with the advancement of technologies and growth of data volumes, these systems began to adopt more advanced methods [4]. Even with enhancements, SMT systems continued to face issues in terms of accuracy and context.

The breakthrough in AI translation came with the arrival of neural machine translation (NMT). NMT systems depend on deep learning and artificial neural networks for large-scale models, which are trained for the generation of translations through the processing of volumes of textual material. While previous systems could only translate a word or a phrase in isolation, an NMT system looks at a whole sentence or paragraph, considering context and word relationships. These systems result in a much more coherent translation, sometimes comparable in quality to that of professional human translators.

Further advances using AI technologies such as transformers and attention mechanisms have drastically improved both the efficiency and quality of neural translation models. The transformer model by Vaswani et al., which was proposed in 2017, represented a huge leap forward from the earlier neural translation models, in that it empowered the system to focus resources on the most relevant part of the text at each instant rather than having to process the entire sequence all at once [5]. Such a development has enabled faster and more accurate translations, particularly for long and complex sentences. AI-powered translation tools can now translate numerous languages with high accuracy levels and are in use across a wide array of services, from e-commerce to healthcare and legal.

In 2024, the team of linguists at Intento ran an experiment to assess the potential of generative AI for translation using large language models. The study covered nine AI models, including GPT-4, Claude-2.1, PaLM 2, among others, and eight specialized MT models from companies like DeepL and Google [6]. The translation focus of the research was from English to Spanish and German, both in general contexts and in specialized fields like law and healthcare. The models are evaluated for several parameters concerning translation speed and quality, where the latter is measured through the COMET semantic similarity metric. It generally confirmed that, in most of the generated results, generative AI achieves translation quality comparable with the best MT systems and significantly drops performance for specialist domains.

The generative models showed competitive translation quality on general topics but, within narrow domains, their accuracy lagged far behind specialized MT tools (fig. 2).

While the cost of translation with Large Language Model (LLM) was much lower, these models were still interesting for large volumes of texts or tasks that required a specific localization. Notwithstanding the bright outlook of generative AI in translation, given certain issues with accuracy for specialized fields, the authors of the study recommend continuing to rely on traditional MT systems.
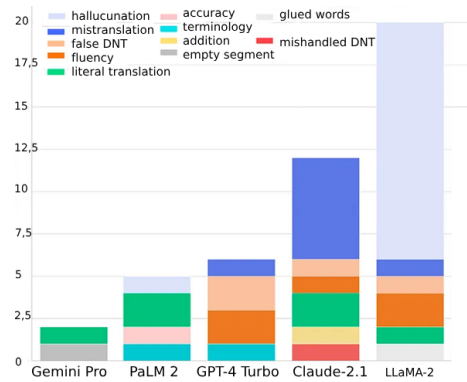

Fig. 2. Number of errors in translating healthcare texts from English to German.

IV. COMPARISON OF TRADITIONAL TRANSLATION METHODS AND AI-BASED METHODS

As mentioned earlier, MT and AI technologies have significantly developed in recent years and provided some alternative means to the traditional methods of translation. However, even with such advancements, most of the professionals in translation still support the traditional methods where human intelligence and expertise are applied to achieve accuracy and account for all nuances of the text. On the other hand, AI can offer great advantages in terms of automation and scalability. It should be kept in mind, however, that the option between the two approaches would depend upon several factors related to the text type, quality requirements, and the resources available for the job. To visually compare the traditional methods of translation with AI-based methods, let us consider several key criteria that play a decisive role in the translation process (table 1).

TABLE I. Comparison of traditional translation and AI-based translation by key criteria [7, 8].

Criterion	Traditional translation (professional linguist)	AI-based translation (neural networks)
Translation accuracy	High. Translators consider context, language nuances, and cultural aspects.	Depends on the model and text complexity. Performs well with simple texts but significantly worse with specialized content.
Translation speed	Depends on text complexity and translator experience. Typically slower, especially for large volumes of text.	Very fast. Can process thousands of words in a few seconds.
Cost	High. Translator fees can be expensive, especially for complex texts.	Low. The cost of using AI is significantly lower, especially for large volumes of text.
Context handling	Excellent. The translator analyzes the text in context and adapts it for the target audience.	Limited. AI models often struggle with context, idiomatic expressions, and polysemous words.
Text complexity	Professional translators can handle any type of text, including specialized areas (law, medicine, etc.).	Best suited for simple and standard texts. Quality may degrade in specialized areas (e.g., medicine, law).
Cultural	High. The translator	Limited. AI may not account

nuances	takes cultural context into account and adapts the text for the target audience.	for cultural differences, sometimes leading to inaccurate or inappropriate translations.
Flexibility	Translators can adapt their approach depending on client requirements and context.	Limited flexibility. AI works according to predefined algorithms and may not always precisely follow specific requirements.

The comparison between traditional translation and AI-based methods reveals that both have their particular advantages and limits. Traditional translation, done by professional linguists, cannot be replaced in complicated and specialized texts, where high accuracy is at stake, considering the context and all the cultural nuances. It works best in tasks that demand a personalized approach, attention to detail, and deep interpretation.

Conversely, AI technologies significantly accelerate translation work and reduce its cost for the client, especially in routine and bulk work. Although AI copes quite well with simple texts, in cases where profound understanding or work in complex, special areas is required, its capabilities are limited. Sometimes, though, AI translation can come in handy: for example, website or interface localization, or when it's necessary to quickly translate large volumes of information. Ideally, both approaches can be used to complement each other in combining the speed and efficiency of AI with the accuracy and depth from traditional translation.

V. PRACTICAL COMPARISON OF TRANSLATION BY A LINGUIST AND A NEURAL NETWORK

With the development of MT technologies and AI, it has become possible to quickly and efficiently translate texts from one language to another. However, despite significant advancements in neural networks and MT, traditional linguistic translation remains an important tool, especially when precision and attention to detail are required. In this section, we will conduct a practical comparison of the translation of the same text from English to Arabic by a professional linguist and a neural network to demonstrate how these methods handle different types of texts.

Example 1: general text (translation from English to Arabic)

Original text: The team celebrated their victory with great enthusiasm, as it was a hard-fought match. They had worked tirelessly for months, and the result was a testament to their dedication and teamwork.

Linguist's translation:

لقد جدًا صعبة المباراة كانت حيث كبير، بحماس بفوزهم احتفلوا العمل فريق
الجماعي وعملهم تفانيهم على شهادة النتيجة وكانت لأشهر، كلل بلا عملوا.

Neural network translation:

تعب بلا عملوا. صعبة المباراة كانت كبير، بحماس بنصرهم احتفلوا فريق
المشترك وعملهم تفانيهم على دليلًا النتيجة وكانت شهور، لعدة.

In this example, the neural network's translation turned out to be quite successful. The key ideas were preserved, and the text remains relatively natural in Arabic. However, there are slight differences in word choice and sentence structure. For example, the neural network used the simpler "عملوا بلا تعب" instead of the more precise "عملوا بلا كلل". Overall, the neural

network's translation does not require significant edits and is suitable for everyday use, where the context does not demand extreme precision.

Example 2: specialized text (translation from English to Arabic)

Original text: The recent advancements in the treatment of multiple sclerosis have led to the development of more effective therapies. New drug regimens have shown promise in reducing flare-ups and improving quality of life for patients.

Linguist's translation:

أكثر علاجات تطوير إلى أدت المتعدد التصلب علاج في الأخيرة التطورات
جودة وتحسين الانتكاسات تقليل في وعدًا الجديدة الأدوية نظم أظهرت. فعالية
للمرضى الحياة.

Neural network translation:

. فعالية أكثر أدوية تطوير إلى أدى المتعدد التصلب علاج في الأخير التقدم
المرضى حياة وتحسين النوبات تقليل في وعدًا جديدة أدوية أظهرت.

In this case, the neural network encountered difficulty in accurately conveying medical terminology. The use of " أدوية جديدة" instead of the more precise "نظم الأدوية الجديدة" reduces the translation's accuracy, particularly in contexts where the distinction between different drug regimens and the drugs themselves is important. Additionally, the translation of "flare-ups" as "النوبات" may be correct in general context, but the more accurate term in a medical translation would be "الانتكاسات", which specifically refers to relapses in chronic conditions like multiple sclerosis. A linguist with knowledge of the medical field would provide a more precise translation, which is crucial for specialized texts where every detail matters.

Thus, when translating general texts, neural networks can be quite effective, providing a fast and acceptable result. However, in cases requiring precision in specialized terminology, a professional linguist remains a more reliable source for accurate translation.

VI. CONCLUSION

In recent years, significant advancements have been achieved in translation, with AI providing fast and efficient tools for text processing. Yet, with all these achievements, the work of a professional linguist remains indispensable in contexts that demand deep adaptation, considering cultural peculiarities. While MT can achieve acceptable quality in standard and simple texts, including state-of-the-art neural networks, their capacity is limited in complex situations that require precision in the transmission of cultural nuances, idiomatic expressions, and contextual subtleties. AI may fail to recognize such aspects or interpret them incorrectly, which can lead to incorrect or even inappropriate translations.

Thus, while AI could be useful in many cases, it cannot replace a human translator in contexts requiring higher levels of understanding context, intercultural communication, and adaptation of texts to the target audience. Expert translators have the experience and knowledge to take into account all the mentioned aspects; therefore, their work turns out to be indispensable for many specific and critical tasks.

REFERENCES

[1] D. I. Inomiddinova, "Modern problems of linguistics and methods of teaching English language," Teoriya i praktika sovremennoy nauki, vol. 3, no. 57, pp. 6–8, 2020. EDN: LGJJTS.

[2] N. K. Daminov, "The role of simultaneous interpretation in the system of types of translation," International Journal on Integrated Education, vol. 5, no. 11, pp. 10–15, 2022.

[3] V. P. Popescu, "The impact of natural language processing on language learning and teaching," in Redefining Community in Intercultural Context, vol. 11, no. 1, pp. 171–175, 2023.

[4] H. Wang, H. Wu, Z. He, L. Huang, and K. W. Church, "Progress in machine translation," Engineering, vol. 18, pp. 143–153, 2022. DOI: 10.1016/j.eng.2021.03.023. EDN: ZQDIUU.

[5] A. Gillioz, J. Casas, E. Mugellini, and O. A. Khaled, "Overview of the Transformer-based models for NLP tasks," in Proceedings of the 15th Conference on Computer Science and Information Systems (FedCSIS), IEEE, 2020, pp. 179–183. DOI: 10.15439/2020F20.

[6] Intento, "Generative AI for translation in 2024," Available: https://inten.to/blog/generative-ai-for-translation-in-2024/#, (accessed: Dec. 23, 2024).

[7] L. Fu and L. Liu, "What are the differences? A comparative study of generative artificial intelligence translation and human translation of scientific texts," Humanities and Social Sciences Communications, vol. 11, no. 1, pp. 1–12, 2024. DOI: 10.1057/s41599-024-03726-7. EDN: LXJHNG.

[8] G. Baisova, "Integration of artificial intelligence into educational programs to develop scientific analysis skills in a multidisciplinary environment," Bulletin of Science and Practice, vol. 10, no. 11, pp. 410–416, 2024. DOI: 10.33619/2414-2948/108/54. EDN: IBCCLX.