

## Voice Recognition As A Translation Tool: Emphasizing The Integration Of Arabic Language

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### ABSTRACT

This study delves into the realm of voice recognition technology, which has undergone remarkable advancements in recent decades, offering notable benefits such as a more seamless and natural interaction between humans and machines, as well as enhanced efficiency for translators. This analysis aims to shed light on the leading voice recognition software available on the market, particularly focusing on the integration and performance of the Arabic language within these systems. By examining the place of Arabic in voice recognition software, we will investigate the challenges and opportunities that arise in ensuring the language's effective representation and functionality, thereby addressing the broader question of how voice recognition technology can better serve diverse linguistic communities.

**Keywords:** voice recognition, translator, Technology advancements, Interactive Dictation Translation, Arabic language.

### INTRODUCTION

Over the past decades, technological advancements have profoundly transformed various sectors, including translation. Innovations such as machine translation, voice recognition, terminology management, and online work platforms have significantly altered the translation process. Tools like Computer-Assisted Translation (CAT) now enhance efficiency and speed. Despite these advancements, human intervention remains crucial to ensure quality and accuracy, particularly during the post-editing phase. Translators increasingly rely on technology to automate certain stages of their work (Idir, 2017, p248).

However, the global impact of these technologies is not uniform across all languages. Languages that are less represented, such as Arabic, face unique challenges and opportunities in this rapidly evolving landscape. For instance, the complexity of Arabic phonology and morphology poses specific difficulties for voice recognition systems. Major tech companies, driven by globalization and the growing demand for high-quality translations, have intensified their focus on developing translation support tools. These tools aim to boost efficiency and productivity for professional translators while enabling a wider audience to translate documents quickly and effectively. Additionally, efforts are underway to enhance machine translation quality through machine learning algorithms and artificial neural networks, particularly for languages like Arabic, where nuanced understanding and cultural context are critical.

In this context, it is essential to highlight the role of the Arabic language in voice recognition software, as it presents a distinctive case in the evolution of translation technologies. This study explores the integration and prominence of Arabic within these technologies and examines how this reflects and influences the evolution of translation tools in a globalized world. The transformation of the translator's profession in response to market demands offers insights into the specific role of Arabic in technological advancements in translation.

### 1. Understanding Voice Recognition

Voice recognition, also known as Automatic Speech Recognition (ASR) or Computer Speech Recognition, represents a major advancement in biometric technology. It allows for the identification and processing of a person's voice by converting speech signals into text or commands, thus facilitating natural language communication between humans and machines (Meng et al., 2012). This technology is utilized across a variety of industries, including smart home systems, healthcare, and public safety (Fegade et al., 2021; Kudryavtsev et al., 2023; Wang et al., 2019). Voice recognition systems now play an integral role in daily life by interpreting dictation, comprehending spoken commands, and even identifying individuals based on unique voiceprints (Tantry et al., 2024).

Despite its advancements and increasing prevalence, voice recognition technology continues to face several challenges. One significant issue is maintaining accuracy in diverse conditions, such as noisy environments or with multiple speakers (Fegade et al., 2021; Yang & Zhao, 2018). Although advanced, these systems often struggle with understanding context, which can lead to misinterpretations, especially with homophones—words that sound the same but have different meanings—resulting in errors during transcription or command execution (Vaissière, 1981). Furthermore, factors such as

accents, speech impediments, and background noise can adversely affect the technology's effectiveness, reducing accuracy and reliability (Sim, 2010; Tull et al., 2001). Despite continuous improvements in algorithms and models, including those using deep neural networks, voice recognition has not yet reached the level of human speech perception (Negoita et al., 2021).

The voice recognition process involves several key steps including the reception and interpretation of dictation, understanding spoken commands, and identifying individuals through their voice characteristics. This technology has been integrated into various applications, such as smart home devices, smart speakers, and authentication systems for secure access (Li et al., 2013).

Voice recognition systems can be categorized as either speaker-dependent, which require training on a specific user's voice, or speaker-independent, designed to recognize any voice. These systems continuously learn from extensive datasets to improve their accuracy, enabling them to understand a wide range of accents, dialects, and speech patterns.

Modern advancements in voice recognition are driven by sophisticated artificial intelligence (AI) and natural language processing (NLP) algorithms. These innovations enhance the technology's contextual understanding, accuracy, and responsiveness, leading to its widespread adoption in various applications such as virtual assistants like Siri, Alexa, and Google Assistant, as well as dictation software, customer service systems, and accessibility tools for individuals who may be unable to use traditional computing devices.

## **2. A Historical Overview of the Emergence of Voice Recognition**

Voice recognition technology, a cornerstone of modern human-computer interaction, has a history that stretches back several decades. The origins of this technology can be traced to the 1950s. However, it wasn't until the 1970s that voice recognition began to gain significant traction. This period saw the introduction of statistical methods based on Hidden Markov Models (HMMs), which utilized stochastic language models, marking a significant leap in transcription accuracy (Charpentier, 2008, p50).

Early systems, such as the one developed by American Bell Laboratory in 1952, were limited in capability, recognizing only numbers spoken by a human operator (PraedictIA). These early systems relied on rigid rules for transcribing speech, which constrained their accuracy and applicability.

Significant advancements followed in the 1980s with the development of microprocessor technology and machine learning algorithms. The introduction of systems based on artificial neural networks greatly enhanced transcription accuracy. This progress laid the groundwork for the expansion of voice recognition technology into commercial applications, such as personal assistants and automated call centers.

The transition from these early developments to contemporary applications can be seen in the rise of artificial intelligence. Post-2010, advancements in natural language processing technologies, AI development, and increased computational power have led to the widespread adoption of virtual assistants. Notably, Apple's introduction of Siri in 2011 marked a pivotal moment, showcasing the ability to understand and respond to user queries in a coherent manner. Following Siri's success, virtual assistants like Amazon's Alexa (2014) and Google Assistant have further solidified the popularity and commercial success of voice recognition technology (Rojas, 2012, p1).

## **3. Fields of Use for Voice Recognition**

Voice recognition technology has become indispensable across various sectors due to its versatility and its capacity to enhance both user experience and operational efficiency. It is widely used in areas such as voice-assisted devices, security systems, and even healthcare, where it facilitates the transcription of medical consultations and enhances interactions with computer systems. This versatility underscores the growing impact of voice recognition on daily and professional life, offering practical and innovative solutions across different contexts.

Voice recognition technology is rapidly advancing across multiple sectors, offering diverse benefits ranging from enhanced efficiency in customer service through automated voice response systems to increased driver safety and convenience in the automotive industry via hands-free controls and navigation. Additionally, it plays a crucial role in accessibility, providing essential support for individuals with disabilities by enabling intelligent control of home appliances and facilitating interactions with technology (Li et al., 2015). In healthcare, speech recognition has transitioned from a novelty to a vital tool for medical record-keeping and radiological reporting (Kudryavtsev et al., 2023). Moreover, the banking, finance, retail, and eCommerce sectors leverage this technology for secure account access, voice-activated shopping, and enhanced customer service. The technology also extends its application to controlling smart cars and smart home systems, showcasing its potential to increase the intelligence and individuality of consumer products (Caranica et al., 2017).

In the educational realm, voice recognition proves to be a valuable tool for enhancing student interaction and engagement. It enables learners to practice pronunciation and receive immediate feedback, which is particularly beneficial in language learning environments. By facilitating the correction of pronunciation errors and providing personalized support, this

technology contributes to a better mastery of language skills. Additionally, in classrooms and e-learning platforms, voice-activated tools and assistive technologies facilitate teaching and learning processes.

In translation, voice recognition plays a crucial role in speeding up the translation process and improving the efficiency of translators. Voice recognition facilitates real-time speech-to-speech and speech-to-text translation, promoting seamless communication across different languages. It allows for the rapid conversion of speech to text, thereby facilitating simultaneous translation and the editing of multilingual documents. This application is essential for professional translators, providing valuable assistance in managing large volumes of content and ensuring translation accuracy. However, despite advancements, challenges persist in the accuracy of automatic speech recognition, which is crucial for effective translation. These challenges include variations in context, speaker accents, and environmental noise (Fegade et al., 2021).

#### 4. Leading Innovations in Voice Recognition Software

Voice recognition software has significantly evolved, allowing users to interact with computers through voice commands. This advancement has seen widespread adoption across various sectors, notably within medical and legal communities, and has been seamlessly integrated into smart devices and applications (Tantry et al., 2024). Despite its widespread use, the software's ability to accommodate users with vocal pathologies, such as those caused by neurological disorders or impairments to the vocal mechanism, remains notably limited (Tull, 2000). Interestingly, while certain systems are designed to tailor to each user's voice for improved accuracy (Cilurzo & Miller, 2003). The industry's efforts to meet the needs of individuals with vocal pathologies have not been fully realized. This is surprising given the potential of speech recognition to be a valuable tool for individuals with disabilities, aiding in learning processes and improving accessibility. Moreover, the financial and operational benefits of voice recognition in healthcare settings suggest even broader potential for these technologies.

Voice recognition software now offers a diverse array of accuracy levels, user interface designs, and feature sets across different platforms. Notable players in this field include:

- **Google Speech Recognition:** Integrated into Google Assistant, this technology is renowned for its high accuracy and ability to understand a wide array of accents and dialects, forming the backbone of Google's voice-enabled services.
- **Apple's Siri:** Embedded across iOS, macOS, watchOS, and tvOS devices, Siri excels in user personalization and task management, leveraging both voice recognition and natural language processing to handle a multitude of functions, from setting reminders to answering queries.
- **Microsoft's Cortana:** Primarily focused on productivity within the Microsoft 365 suite, Cortana remains a powerful tool for voice commands and task management, reflecting its strong foundation in voice recognition technology.
- **Amazon Alexa:** Powering Amazon's Echo devices, Alexa is celebrated for its smart home integration, allowing users to control various smart devices, execute voice commands, and interact with numerous "skills" that extend its functionality.
- **IBM Watson Speech to Text:** Known for its robust enterprise solutions, IBM Watson offers powerful transcription capabilities, multilingual support, and customization options tailored to diverse industries.

However, **Dragon NaturallySpeaking** stands out as a premier voice recognition software in the professional domain. Developed by Nuance Communications, Dragon NaturallySpeaking is celebrated for its high accuracy and flexibility in voice dictation and computer control. It enables text dictation, computer function control, and task automation through voice commands, continuously learning and adapting to individual speaking styles. Nuance Communications claims a remarkable 99% accuracy rate for Dragon NaturallySpeaking, underscoring its efficiency and reliability in professional settings. Despite its higher cost—professional versions priced around €699, with more affordable options starting at €199—the software supports multiple languages, including English, French, Spanish, German, Dutch, and Italian. Nonetheless, a critical limitation is its lack of support for Arabic, highlighting broader investment and political challenges in the Arab world regarding voice recognition technology. This absence underscores a significant gap in the software's inclusivity and points to the need for further development and commitment to integrating less-represented languages like Arabic into leading voice recognition platforms.

#### 5. Integration of Voice Recognition and Translation Technologies

The 1990s marked a significant milestone for voice recognition technology with the release of IBM's "IBM Personal Dictation System" in 1994. Operating on a PC 486 with an accelerator card and microphone, this system achieved a 95% recognition rate and a dictation speed of 80 words per minute. It allowed for the storage of dictations in editable sound files and was available in five languages. Subsequent innovations from IBM, such as VoiceType 3.0 in 1996, introduced continuous dictation and command capabilities integrated into OS/2 Warp 4. The MedSpeak/Radiology software offered continuous voice recognition with an average accuracy exceeding 95%, while VoiceType Simply Speaking and the VoiceType 3.0 developer toolkit facilitated broader integration of voice recognition into various applications, from interactive video games to productivity and e-learning tools (Besson & Reboul, 2000).

Before the digital revolution, translators employed typewriters and either direct translation or dictaphone-assisted methods. In the dictaphone approach, after thorough preparation and research, translators would record their translations, which were then transcribed by typists. This method is akin to contemporary voice recognition-assisted translation, where advanced transcription software replaces the typist. In this modern context, voice recognition transcribes spoken language into text, which can then be translated and synthesized into spoken output (Carcasses, 2021, p100).

### **5.1. Advancements in Voice Recognition and Their Impact on Translation Technologies**

Voice recognition serves as an initial step in capturing and transcribing spoken language, which is subsequently translated into another language. The synergy between these technologies has led to the creation of sophisticated tools that support instantaneous communication across linguistic boundaries, fostering a more interconnected global society.

The intersection of voice recognition and translation technologies represents a crucial advancement in enhancing cross-linguistic communication. Together, these technologies enable real-time spoken language translation, bridging communication gaps across different languages and cultures. Here's how they interrelate:

**1. Seamless Process Integration:** Voice recognition captures spoken input and converts it into text, which is then translated into the target language. Some applications further utilize text-to-speech technology to provide audible output in the target language.

**2. Enhanced Accessibility:** Combining voice recognition and translation breaks down language barriers, making information and communication accessible to diverse linguistic communities. This integration is particularly beneficial in global business, travel, education, and customer service contexts.

**3. Time Efficiency:** Reducing the time needed for manual transcription (...) professionals like translators and subtitlers can save a substantial amount of time on the task of transcribing spoken content. With this time-saving benefit, they can redirect their efforts towards the linguistic aspects of their work. (matesub, 2023)

**4. Machine Learning and AI:** Advances in artificial intelligence and machine learning have significantly improved both voice recognition and translation technologies. Enhanced accuracy in voice recognition accommodates various accents and dialects, while AI-driven translation models offer more contextually relevant and natural translations, fostering a smoother voice-to-text-to-translation process.

**5. Applications and Devices:** The integration of these technologies is evident in mobile apps (e.g., Google Translate), wearable devices, and smart assistants (e.g., Google Assistant, Amazon Alexa). These tools not only recognize and translate spoken words but also provide audible translations in a streamlined manner.

### **5.2. Enhancing Translation through Interactive Dictation**

Technological advances have led to unprecedented changes in translation (Doherty, 2016: 947). Among these innovations, the convergence of translation and speech recognition technologies has led to the development of "Interactive Dictation Translation" (IDT), a significant breakthrough within the realm of Natural Language Processing (NLP). IDT harnesses the power of speech recognition technology, enabling users to dictate the text they wish to translate. This method, which seamlessly blends cutting-edge advancements such as speech recognition and touch-screen mobile devices with traditional practices, is rapidly gaining popularity for its efficiency in saving time and reducing transcription errors. IDT proves particularly valuable in fields where multilingual communication is crucial, including travel, international business, healthcare, and emergency services.

The growing body of research underscores the effectiveness of IDT. Previous studies have demonstrated that the use of automatic speech recognition (ASR) tools for dictating translations significantly boosts productivity (Wang & Sun, 2023, p1). This process involves the translator dictating the target text to software capable of handling transcription automatically. The software not only facilitates corrections or modifications but also supports various translation, linguistic, and computational tasks (Rojas, 2012, p1). The versatility of IDT ensures that translators can achieve accurate and efficient translations, streamlining workflows in increasingly demanding environments.

Reflecting on these advancements, a recent article on the Canadian website "InTr Technologies & Language Services" delivers a compelling vision: "In 2023, it is high time to say 'Goodbye to the keyboard!' and embrace orality and multimodality. In the coming years, it is the reinvented dictation translation" (Julianz, 2023). This forward-looking statement resonates with the rapid pace of technological evolution and shifting cultural dynamics, which necessitate a reassessment of traditional communication methods. Reimagining dictation translation signifies the potential to transcend linguistic boundaries, offering a more interactive and natural approach in our technological interactions. As we acknowledge the growing power of machines in translation, it becomes increasingly clear that human capabilities may not match this technological prowess. However, this reality should not be viewed as a threat but rather as an opportunity. By embracing collaboration between human and machine strengths, we can not only enhance efficiency but also free up time for more creative and intellectually stimulating endeavors. Rather than perceiving technological advancement as competition, fostering a harmonious synergy where human and mechanical strengths complement each other is the way forward.

## 6. Evaluating the Impact of Speech Recognition on Translation Efficiency and Challenges

In the realm of professional translation, the integration of speech recognition technology has brought about significant advancements and improvements. As the field evolves, understanding both the benefits and limitations of this technology is crucial for optimizing its use. This analysis will explore the advantages that speech recognition offers to translators, including increased efficiency and improved ergonomics, as well as the challenges it presents, such as difficulties with accents, complex sentences, and language support disparities. By delving into these aspects, we can better appreciate how speech recognition reshapes translation practices and identify areas for further development.

### 6.1. Advantages of Speech Recognition for Translators

One of the primary reasons for integrating speech recognition systems into professional translation is their ability to save time and enhance productivity. For instance, while a person speaking at a normal rate articulates approximately 180 words per minute, manual typing averages around 60 words per minute. The time saved through speech recognition can be redirected towards improving the quality of the linguistic transfer itself. Additionally, the verbal nature of speech recognition can contribute to a better quality of life; for example, reduced keyboard use lowers the risk of developing carpal tunnel syndrome. Furthermore, translators can stand, sit, or move around while using a headset, which can alleviate back pain. Speech recognition also boosts productivity by allowing translators to work faster and more efficiently. It enables them to dictate translations, potentially accelerating their workflow and decreasing the workload associated with manual typing. Moreover, interpreters can use speech recognition to take notes during speeches or conversations.

### 6.2. Limitations of Speech Recognition for Translators

Despite its advantages, speech recognition systems have their limitations and cannot yet surpass human auditory capabilities (Russo, 2022 : 101). These systems may struggle to accurately recognize accents, dialects, and regional variations, leading to potential transcription errors. They can also have difficulty with complex sentences or idiomatic expressions. Background noise and noisy environments can further degrade the quality of speech recognition, resulting in inaccuracies and incorrect translations. Additionally, speech recognition may face challenges distinguishing between homophones and paronyms. For example, a spoken term like "barely" might be misinterpreted as "bearly," or "their" as "there," altering the intended meaning of a sentence. Misrecognitions such as "flour" as "flower" or "serial" as "cereal" can also impact context significantly. Furthermore, not all languages are equally supported by speech recognition software. Languages spoken in poorer regions, such as many African and Asian languages, are often neglected due to lower profitability and inadequate databases, which require extensive recorded dialogue hours to develop effective systems (Kassataya, 2018). The question remains: how does Arabic fit into this landscape?

## 7. The place of the Arabic language in speech recognition world

The ongoing advancements in Arabic Automatic Speech Recognition (ASR) have attracted significant scholarly attention, with initial efforts yielding promising, albeit limited, implementations. Research in this area is essential, particularly due to the applicability of voice recognition technologies in various digital environments such as smart homes, vehicles, and Internet of Things (IoT) devices. However, the development of ASR systems for Arabic faces considerable challenges, including the complexity of its phonetic and grammatical structures, the dominance of non-diacritized text material, and the diversity of dialects (Abdou and Moussa 2018:1). These factors necessitate specialized approaches to ensure effective speech recognition. Although the field is expanding, it remains in its early stages compared to other languages, with noteworthy methodologies like deep learning models, such as DeepSpeech, being explored (Oukas et al., 2022). As research continues, the focus remains on overcoming these obstacles to advance the integration of Arabic within the broader speech recognition landscape (Abdul Raheem, 2023).

### 7.1. Current Implementations and Key Players in Arabic Speech Recognition

The introduction of Arabic into voice recognition software is a significant step toward inclusivity, allowing Arabic-speaking users to interact with technology seamlessly in their native language. However, the level of support for different dialects can vary, with most systems focusing on Modern Standard Arabic. Ongoing advancements in artificial intelligence and machine learning continue to improve the accuracy and usability of these systems for Arabic speakers around the world.

Various voice recognition software and platforms offer support for the Arabic language. These systems range from consumer-focused applications to professional solutions. Here are some notable examples:

**1. Google Speech-to-Text:** Part of the Google Cloud suite, this service provides powerful speech recognition capabilities and supports Modern Standard Arabic among other languages. It is used for a variety of applications, including transcribing audio from video content and enabling voice commands.

**2. Microsoft Azure Speech to Text:** Microsoft's cloud-based speech recognition service supports Arabic, providing real-time transcription, and is applicable in creating interactive voice response (IVR) systems, transcribing meetings, and more.

**3. IBM Watson Speech to Text:** IBM Watson includes Arabic in its multilingual speech recognition service, which is designed for various use cases, such as customer service automation and multimedia transcription.

**4. Apple Siri:** Siri supports Modern Standard Arabic, allowing users to use voice commands for tasks like sending messages, making calls, and searching the internet on their iOS and macOS devices.

**5. Amazon Alexa:** Although Alexa's primary language offerings have been English and European languages, efforts and developments towards integrating Arabic, especially the Gulf dialect, have been reported, aiming to cater to the Middle Eastern market.

**6. Speechmatics:** This speech recognition technology, offering a wide range of language support including Arabic, is used in various applications, from real-time subtitling to analytics.

### 7.2. Challenges in Arabic Voice Recognition

Contrary to popular belief, the Arabic language is increasingly attracting attention from developers and researchers in the field of voice technology. Notably, systems like SATORI have created Arabic voice recognition systems based on Carnegie Mellon University's CMU Sphinx-4, with applications demonstrating the adaptability of this system to the Arabic language (Satori et al., 2007, p.34). Furthermore, various online applications and services, such as Talktyper, Sonix, Lingo, VoiceTra, Happyscribe, and Notta, provide Arabic language transcription services.

However, it is undeniable that Arabic has lagged considerably compared to languages such as English, French, Spanish, and Dutch in the domain of voice recognition. This linguistic gap has impeded the full development of this technology for Arabic-speaking users. Despite this, the potential for progress is immense, and the need is urgent. To address this issue, it is imperative for policymakers and stakeholders in the Arab world to collaborate, investing financial resources and initiating targeted research initiatives. Such efforts could not only mitigate the existing gap but also position Arabic at the forefront of technological innovation. A unified vision and commitment to this cause could transform this challenge into a promising opportunity, ensuring equitable access to voice recognition technology for Arabic speakers.

To those who still doubt the adaptability of the Arabic language to various programs and speech recognition software, consider the following example: "An automatic language recognition system was designed and adapted specifically for the recognition of the Arabic language. The system was based on CMU Sphinx-4 from Carnegie Mellon University." This demonstrates that it is merely a matter of will, research policy, and resources to enhance the presence of the Arabic language in the digital world. (Satori et al., 2007, p4)

In an article by Sameer Mohanad and collaborators, the authors proposed an Automatic Speech Recognition (ASR) system for the Arabic language. This system employs a transformer architecture that leverages attention mechanisms with positional encoding to capture positional dependencies. The ASR model was trained exclusively on Modern Standard Arabic, without the integration of a language model, utilizing only 112 hours for both training and evaluation. (Sameer et al., 2023:182)

Reflecting on these experiences with speech recognition and the Arabic language, it appears that the primary barrier to further research is not the complexity of the Arabic language itself, but rather the willingness to advance its integration. Arabic, in essence, is no more challenging than any other language in the context of speech recognition and translation technologies.

### 7.3. Future Perspectives for Speech Recognition in Translation

The future of speech recognition holds exceptionally promising prospects. By 2030, nearly 80% of online information searches are expected to be conducted via voice. Whether through smartphones or connected assistants, voice commands are set to assert themselves with undeniable power, as noted by Colombain (2019). With rapid advancements in artificial intelligence and machine learning, the efficiency of speech recognition is anticipated to see significant improvements, particularly regarding the recognition of accents and idiomatic expressions. Furthermore, the utilization of technologies such as automatic speech recognition and automated translation is leading to the development of real-time translation tools, which are invaluable in the realm of instantaneous multilingual communication, such as international conferences and live events. An emerging trend within the domain of speech recognition is the progressive rise of contextual recognition, based on contextual analysis. This approach involves the software's ability to understand the background of an utterance and the underlying intentions of the user. To achieve this, additional elements such as spatial-temporal settings and prior interactions are integrated to create a more nuanced and refined understanding.

## 8. Conclusion:

Voice recognition technology, at its core, represents a fascinating duality for translators. On one hand, it introduces speed, ease, and enhanced productivity into the writing process, providing a seamless flow where words take shape effortlessly. On the other hand, this technology reveals its limitations—errors and misunderstandings can arise when subtleties and nuances escape its grasp, particularly when mispronunciations or background noise disrupt word recognition. Thus, finding a balance between utilizing voice recognition and the essential role of human revision becomes crucial to ensure accurate and faithful translation.

Nevertheless, with ongoing and steadfast technological advancements, the future of voice recognition—and by extension, the field of translation—appears promising. Yet, as we look ahead, a pressing concern emerges: the state of translator training in Algeria, where theoretical aspirations often overshadow practical realities. It is imperative to integrate the latest technological developments into the broad spectrum of translation practices.

However, as we move forward, a pressing question arises: how can we better equip translators to navigate the ever-evolving technological landscape? What innovative strategies can we employ to bridge the gap between theoretical knowledge and practical application in translation training? This challenge invites us to rethink our approach and explore new avenues for integrating cutting-edge tools into the translator's toolkit. Moreover, it is imperative that we work towards a more robust integration of the Arabic language into all programs and software. This responsibility falls squarely on the shoulders of Arab computer engineers and linguists, who must rise to this crucial task. We must not wait for the West to take the initiative on our behalf.

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