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Artificial Intelligence Based Language Translation Platform

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Abstract: The use of computer-based technologies by non-native Arabic-speaking teachers for teaching native Arabic-speaking students can result in higher learner engagement. In this study, a machine translation (MT) system is developed as a learning technology. The proposed system can be linked to a digital podium and projector to reduce multitasking. A total of 25 students from Prince Sattam Bin Abdulaziz University, Saudi Arabia participated in our experiment and survey related to the use of the proposed technology-enhanced MT system. An important reason for using this framework is to exploit the high service bandwidth (up to several bandwidths) made available for interactive translation services. The framework is deployed by linking it to a video camera, digital podium, and projector in each classroom for the translation operation. Accordingly. After employing the system, the effect on the understanding of the students of the technical aspects of the subject that was taught using English was evaluated. The results indicated that the use of the developed technology for translation during classroom sessions was beneficial. Furthermore, the engagement of students in the classes improved their performance and learning outcomes. The students also commented that the proposed framework is useful from two perspectives: vocabulary improvement and subject comprehension. Many of the students indicated that working on assignments and homework using the framework was useful because words difficult to understand were translated.

Keywords: Network; information science; machine learning; multimedia; server; client; language translation; application programming

1 Introduction

Many studies have suggested that active learning concepts should be used for teaching when the native languages of teachers differ from that of students. In particular, teaching the English language is exigent in the Middle East [1–4].

In Saudi Arabia, teaching of the English language has attracted considerable interest for research because most of the students are native Arabic speakers, whereas many members of the faculty are non-native Arabic speakers. As a result, these students find it difficult to understand the lessons and technical aspects of subjects being taught by foreign teachers, eventually derailing the academic program's mission and vision and detrimentally affecting student learning outcomes. Furthermore, unlike in other countries,

although English is taught at the primary school level, the Kingdom of Saudi Arabia has not attached considerable importance to the English language. Consequently, problems arise when these students enroll in technical schools or colleges. Evidently, the traditional approach to classroom learning becomes problematic if teachers and students do not share a common language to communicate [5].

In this paper, the use of an instant MT service is proposed. The use of PowerPoint presentations (PPTs) is included with the proposed service because Prince Sattam Bin Abdulaziz University (PSAU) and its affiliated colleges use digital podiums and projectors in the classrooms. Most of the universities in Saudi Arabia under the Ministry of Education employ a similar setup, in which blackboards are equipped with projectors and digital podiums; thus, the implementation of the proposed method using these hardware is feasible. When students struggle to understand any English word presented in the PPT, the proposed framework can aid students to understand it by immediately providing a translation, allowing the students to learn and the faculty members to teach in a typical classroom environment. Moreover, the use of multimedia equipment has been observed to increase the attentiveness of students [5]. Numerous MT systems are available; however, they cannot be linked to PPTs because they are third-party solutions. It was found that teachers who multitasked in the use of the medium of instruction scored lower in their evaluations than those who were not involved in multitasking. Hence, the proposed service has been developed in such a way that it can be easily linked to a PPT to display the instant translation on the same PPT slide being presented by the teacher [6–8]. Different from earlier MT systems based on human intervention, recent technological advancements have enabled the translation of source documents into various languages using advanced machine learning techniques.

Babelfish.com aids thousands of daily users with its free online translation service. However, after its inception in the World Wide Web, users started to report translation errors, which the founder and providers of the service did not expect [9–12]. To date, although Babelfish.com still provides translation services, it is not utilized by Google. In 1997, it was the only site that provided many important services to the Internet community and thus became a source of inspiration for many researchers who intended to develop translation services with more advanced features, such as those of Google. In recent years, because of their increasing necessity, translation services offered on the Internet, particularly computer-based translation, have been widely used. An adaptive MT service [13] can improve translation performance. This is achieved by having the source language and machine-translated text reviewed and modified by humans [13–16]. In this approach, an appropriate translation material is fed to the machine as training material. After correction, the completed text is forwarded to the user who requested the translation. Most recently, numerous studies have attempted to deliver mechanisms for language translation at the communication and operation (physical) levels particularly in the areas of neural sign language [17–19], spoken language [20], and health care [21]. Many online translation services use machines; however, machine-translations are inferior to those provided by humans. Only a few services are reliable and can translate the source text into many languages using highly sophisticated machine learning algorithms. Among these is Google Translate, which uses machine learning concepts for language translation; the speed at which it outputs the translated text is appreciable.

In this study, an English language translation framework (ETF) is designed, implemented, and evaluated. The ETF is intended for text translation in live classes by linking it to classroom devices based on the PSAU network. The text requiring translation is called source text; it is entered into the source text box of the client interface displayed on the screen of the faculty's device. The source text is identified by the ETF servers to obtain the target language translation, and the translated text can be transmitted to the faculty's device during the class. Compared with existing translation services, the proposed method provides the following features: (1) It auto-detects the source language, (2) allows users to store translated text in the glossary, (3) affords batch translation, and (4) allows the use of representational state

transfer application program interface (REST API). The experimental results show that the translation service is well accepted by students because it can save a considerable amount of time during live classes.

The remainder of this paper is organized as follows. In Section 2, the proposed ETF is introduced and its modules are described. Section 3 elaborates on the two types of experiments that are based on translation techniques that employ a database exclusively for translation. This section also presents the results of the performance metrics for both techniques. The conclusions are summarized in Section 4.

2 Proposed Solution

During classes, the ETF can be used by faculty members who find it difficult to convey the meaning of English words or sentences. The client and server networks are shown in Fig. 1.

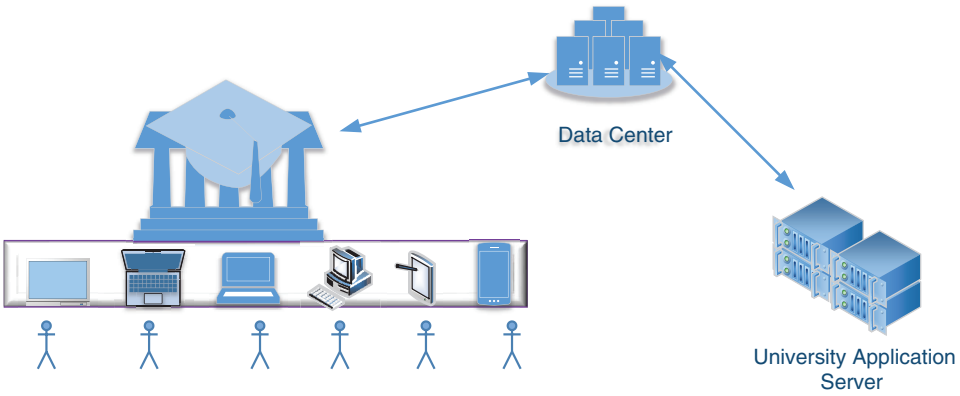

Figure 1: English translation network

Clients can access this framework through their computers or laptops and handheld devices, such as mobile phones and tablets. To access the framework, it is always necessary to login to the PSAU website (www.psau.edu.sa). This website also allows clients to download their courses for the current semester through their individual accounts and dashboards.

The PSAU (www.psau.edu.sa) server affords many services to students and faculty members. For example, students can see their attendance and grades through the blackboard, library service, and candidature information. Hence, the integration of the proposed ETF into this website is also anticipated. An English translation client (ETC) communicates with the PSAU server, which then communicates with the Google Cloud translation server upon receiving a translation request. A cloud translation application programming interface, which is accessible via the Google Cloud platform, is used; customers can integrate Google Translate into their own site or application. The use of Google Translate API is governed by terms and conditions: for example, customers are required to adhere to certain layout rules and branding. The following must be strictly observed by customers who employ the Cloud Translation API service in their websites.

- Users should be made aware that the translation results have been exclusively generated by Google.
- The application states that the application utilizes Google Translate and is governed by the Google Cloud Translate API.
- The application should never attempt to alter the results of Google Cloud translation displayed on the web page.
- All projects should have proper credentials before the Google Cloud Translate API is applied.
- Programming for clients is achieved with the aid of API libraries.

2.1 Translation Environment

Before using the translation service, it is necessary for the faculty member to choose a translation model. Google Translate offers three models: neural machine translation (NMT), phase-based machine translation (PBMT), and autoML translation. The ETF enables PSAU clients to dynamically translate processed languages using the pre-trained machine learning models provided by Google. As shown in Fig. 2, the training of custom-made models is allowed with the AutoML translation service of Google, enabling the input of a matching pair of sentences in the source and target languages. When a client requests translation through the API, the Google platform implements the NMT techniques. The translation process using machine learning techniques is illustrated in Fig. 2.

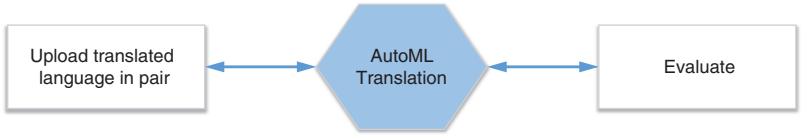

Figure 2: AutoML translation process

An important reason for using this framework is to exploit the high service bandwidth (up to several bandwidths) made available for interactive translation services. The ETF is deployed by linking it to a video camera, digital podium, and projector in each classroom for the translation operation. Accordingly, the faculty members can avail of ETF services via the camera, digital podium, and projector. The classroom is through wired and wireless connections to the PSAU network. To remotely serve students and faculty members, multiple mobile and handheld smart devices roaming within the university are monitored by the servers on the campus. The following settings are employed for the translation through Python programming.

- Enable Authentication
- Set Environment Variables
- Translate Text
- Write Translate Function with Glossary
- Update Permissions
- Create Glossary File
- Upload Glossary to GCS (Google Cloud Storage) Bucket
- Build Custom Model with AutoML Translate
- Train AutoML Model

The proposed model is supported by the platform. Accordingly, Google Translate API uses the NMT model; otherwise, it employs the PBMT model. For translating image-based inputs, the following steps are applied.

- Upload the image to the cloud storage.
- Cloud API is automatically activated to read text.
- There is a queue for each target language.
- There is no queue if the user intends to extract text from the image.
- All translated results are stored and queued.
- With the aid of the API, result queues are saved back into the cloud storage.
- All translated jobs are presented as text files.

2.2 Client Interface

The client interface is shown in Fig. 3 below. It is necessary for students and faculty members who use the ETC for the first time to register with the ETF server. To build a user database, user preferences, such as username, password, and interface color and language are sent to the server. After the construction of the general interface preferences of students and faculty members, the users can use Facebook, Google email, or any other suitable means to register. Once the users are successfully logged into the ETF server, they can use the ETF client interface to input a word or sentence using their mobile phones or personal computers. The ETF clients can then browse through the course materials of their present classes.

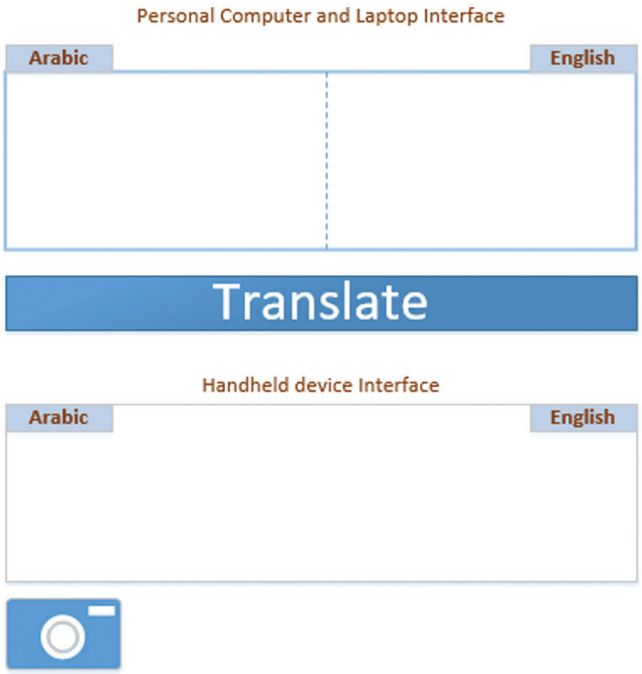

Figure 3: Client interface

Translation requests can be initiated by ETCs only when they are logged into the PSAU server using their credentials. The client module consists of a text space to key in an English word; a camera interface allows users to capture an image of a word or sentence for translation. The captured image of the sentence is then displayed on the screen, and the user is prompted to rub the image to convert it to text. The ETC sends this text to the Google Cloud server for translation. Thereafter, the translated text is sent back to the PSAU server. The ETF clients, particularly mobile device users, indicate the source language (typically English). To read the source language text, the user can then rub the screen with their fingers. If the text-capture was not successful, the users are asked to recapture the text. The ETF client transfers the source text to Google Cloud for translation into Arabic. After receiving the source text, the Google Cloud server attempts to translate it. If the source text cannot be translated because of network problems, the user is prompted to resend it. The communication between PSAU and Google Cloud translation servers is shown in Fig. 4.

When a request for translation is received by the PSAU server, it first checks the local dictionary for the availability of a translated text before sending data and requesting for Google Cloud translation (GCT). If the dictionary contains a translation of the text, then the request would not be forwarded to the GCT. The dictionary is a database of words and sentences that have been previously translated. If the GCT service

is necessary, the communication between the PSAU server and GCT is based on the API. More information on these APIs can be directly obtained from the following link: https://translate.google.com/intl/en/about/forbusiness.html. For the programming employed in this study, some libraries required by the GCT framework are imported; some of these are as follows.

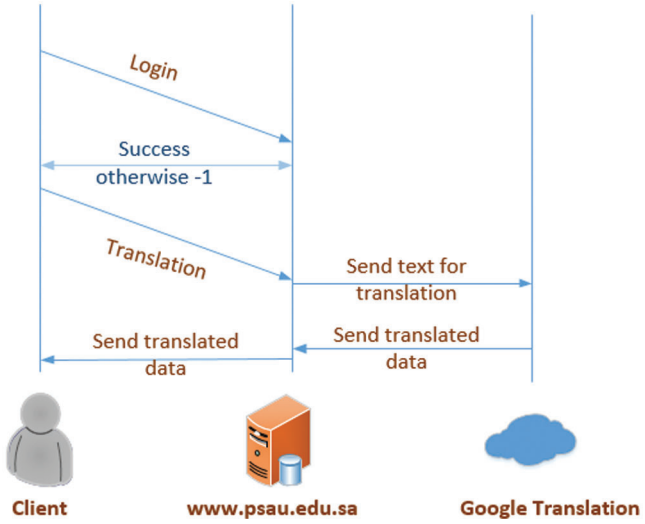

Figure 4: Communication between the client and server

1. Google.Cloud.
2. Translate.V2;

This is suggested by the Google language framework library for using the translation API. It contains the Google.Apis.Translate.v2 client library to facilitate the translation in the client code. The translated API translates text from one language to another. For the dictionary, Algorithm 2, which is proposed in [15], is employed. Each time a translation is requested, the PSAU server is made aware of the request through the API, which is used by the ETF clients via the PSAU server. The PSAU server prepares metadata for the requested translation of the text or word and stores these in the database for future reference.

2.3 Server Module

The client server module is capable of sending and receiving translated text. It can transmit the source text from the client to cloud servers according to the target language, map the recognized translated text back to the client, and save this information in the database. In the event that another client submits a request for the translation of the same text, the client module simply refers to the database for saved translations rather than sending data to the server. The stored translated text is transmitted immediately via a dedicated client program.

3 Evaluation

This section presents the evaluation of the ETF implementation [15]. The evaluation was conducted in a university laboratory where language translation experiments, especially on Arabic text, were performed. In the near future, it is planned to place the proposed server in the cloud. To evaluate the proposed system, the Windows operating system was used as the client and server; the experimental setup details are summarized in Tab. 1. Some English text was sampled from the presentation slides (including subject titles) prepared by

various faculty members. Some faculty members were requested to submit duplicate slides with modified subject titles. The texts and sentences were translated to utilize and measure the developed and borrowed APIs as well as several interfaces that were interlinked with the proposed system.

Table 1: Hardware configuration of physical and guest machines used for experimental setup

Node	Type	CPU
Server	Dell PowerEdge R710	Intel(R) Xenon (R) CPU ES-2670 @ 2.6 GHz and 2.59 GHz, 16 GB RAM
PC1@university	OptiPlex 3020 Micro	Intel ® Pentium G3250T Processor (Dual Core, 3 MB, 2.8 GHz w/ HD Graphics)
PC2@university	OptiPlex 3020 Micro	Intel ® Pentium G3250T Processor (Dual Core, 3 MB, 2.8 GHz w/ HD Graphics)

The dictionary of the proposed framework containing words and sentences collated from various courses was evaluated. These words and sentences are stored in the database according to the course ID (represented as course_name_ID; e.g., ComputerNetwork_CS422). The duration of the translation process for each word or sentence from the time the translation started to the time it was completed was also measured and analyzed for comparison with the time required by the ETC; Tab. 2 summarizes the time required for translating Arabic words and sentences. The performance of the dictionary module was also evaluated; Tab. 2 also lists the time required to compete the translation using the dictionary. The latencies of dictionary access within the ETC were lower than those of GCT, as shown in Fig. 3. Because the ETC stores translated data into the database, subsequent requests for the translation of the same words and sentences are derived from the local database. However, the GCT operation requires a small amount of additional time.

Table 2: Duration of translation service

Case	Average time using ETC	Average time using GCT
Word	0.35 s	0.25 s
Sentence	0.35 s	0.28 s

The experience of the authors and various sources indicate that the English language proficiency of students was poor. However, the use of translation services over the Internet is anticipated to fill this gap. For instance, certain courses that are taught by non-native Arabic speakers require translation software. The proposed ETF software can preclude plagiarism; it can also be reorganized to include more features such that it can work independently without the intervention of the GCT API; the ETF is thus proposed as an alternative to Google Translate. By using the proposed platform, students can follow the lectures without needing to use the browser. The ETF was developed for the courses of PSAU and evaluated by using it in a small-group setting pilot study. The evaluation results showed that the ETF can be potentially used by non-native Arabic speakers. In the pilot study, all these students (all male students) were requested to respond to a survey questionnaire; the responses reflected a high overall satisfaction. In particular, most students, after completing the course, agreed that the ETF significantly improved their understanding of the subject. Some students expressed the necessity of similar sessions in other subjects that are taught by non-native Arabic speakers. Overall, the evaluation ratings given by the students after

using the ETF were satisfactory, as summarized in Tab. 3. The students also commented that the proposed framework is useful from two perspectives: vocabulary improvement and subject comprehension. Many of the students indicated that working on assignments and homework using the ETF was useful because words difficult to understand were translated. All students indicated that no significant time was spent in configuring and installing the framework.

Table 3: Average values of survey responses: 5, strongly agree; 4, agree; 3, neutral; 2, disagree; 1, strongly disagree

Question	Student response
Was data retrieval from the system difficult?	No = 4.7, Yes = 0.3
Was the framework useful for improving your writing skills?	Yes = 4.6, No = 0.4
Did the framework improve your comprehension of the subject?	Yes = 5
Was your laptop processor burdened by the framework workload?	Yes = 3, No = 2
Did the ETC framework aid you to gain new skills?	Yes = 4.8, No = 2

4 Conclusion

Currently, the proposed system uses a pre-trained model from Google Translation API; hence, it can support many languages, including English and Arabic. The proposed framework was constructed with the aid of AutoML, which is a Google translation module. The ETF system affords four advantages. First, auto-detection language is supported: when a user does not know the source language, the ETF automatically identifies it. Second, the ETF has glossary support: the glossary of Google Translation API allows the storage of translated words and sentences. Third, batch-wise translation is possible: This allows the network administrator to reduce the network load of translating large input files. Fourth, Google REST API can be integrated into the system: this reduces the burden of text extraction from documents. Accordingly, the use of the ETF as a centralized translation service is proposed to improve student-oriented learning outcomes.The ETF has several unique features. It uses a standard GCT translation service and API interface for translation; thus, it is error-free and flexible in terms of choosing the proper translations of words. With these flexibilities, it is anticipated that the ETF will be deployed in the PSAU server. The development of the ETF is the first step. The following useful interfaces may be added to the ETF system: an interface for enhancing the ETF to translate a given source language into any language and another interface for reducing the network overhead caused by the dictionary. Future work will be focused on further refinements of the network and AI solutions.

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References

[1] I. A. Khan, "Learning difficulties in English: Diagnosis and pedagogy in Saudi Arabia," *Educational Research*, vol. 2, no. 7, pp. 1248–1257, 2011.

[2] R. N. Kazi, "Active-learning for nonnative-English-speaking students," *Euromentor Journal Studies About Education*, vol. 9, no. 4, pp. 105–111, 2018.

[3] M. R. Ghorbani and S. E. Golparvar, "Modeling the relationship between socioeconomic status, self-initiated, technology enhanced language learning, and language outcome," *Computer Assisted Language Learning*, vol. 1, no. 1, pp. 1–21, 2019.

[4] F. Rosell-Aguilar, "Autonomous language learning through a mobile application: A user evaluation of the busuu app," *Computer Assisted Language Learning*, vol. 31, no. 8, pp. 854–881, 2018.

[5] E. C. Schmid, "Potential pedagogical benefits and drawbacks of multimedia use in the English language classroom equipped with interactive whiteboard technology," *Computers & Education*, vol. 51, no. 4, pp. 1553–1568, 2008.

[6] F. W. Sana and N. J. Cepeda, "Laptop multitasking hinders classroom learning for both users and nearby peers," *Computers & Education*, vol. 62, no. 2, pp. 24–31, 2013.

[7] E. Downs, A. Tran, R. McMenemy and N. Abegaze, "Exam performance and attitudes toward multitasking in six, multimedia-multitasking classroom environments," *Computers & Education*, vol. 86, no. 1, pp. 250–259, 2015.

[8] W. Zhang, "Learning variables, in-class laptop multitasking and academic performance: A path analysis," *Computers & Education*, vol. 81, no. 4, pp. 82–88, 2015.

[9] F. Gaspari and J. Hutchins, "Online and free! ten years of online machine translation: Origins, developments, current use and future prospects," *Proc. of the Machine Translation Summit XI*, London, United Kingdom, pp. 199–206, 2007.

[10] S. Yates, "Scaling the tower of babel fish: an analysis of the machine translation of legal information," *Law Library Journal*, vol. 98, no. 3, pp. 481–500, 2006.

[11] R. F. Terry, L. Allen, C. A. Gardner, J. Guzman, M. Moran *et al.,* "Mapping global health research investments, time for new thinking-A Babel Fish for re-search data," *Health Research Policy and Systems*, vol. 10, no. 1, pp. 521, 2012.

[12] J. Yang and E. D. Lange, "Systran on altavista a user study on real-time machine translation on the Internet," Association for Machine Translation in the Americas, Berlin, Germany, pp. 275–285, 1998.

[13] M. Kolhar, A. Alameen and S. B. AlMudara, "A proposal to detect the double submission of a manuscript sent for review," *Science and Engineering Ethics*, vol. 24, no. 4, pp. 1315–1329, 2018.

[14] H. Denizalp and F. Ozdamli, "Determination of student opinions on usage of social media and mobile tools in student-teacher, student-student communication," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 14, no. 22, pp. 19–28, 2019.

[15] L. Krasnova and V. Shurygin, "Blended learning of physics in the context of the professional development of teachers," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 14, no. 23, pp. 17–32, 2019.

[16] C. Tsihouridis, D. Vavougios, M. Batsila and G. Ioannidis, "The optimum equilibrium when using experiments in teaching where virtual and real labs stand in science and engineering teaching practice," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 14, no. 23, pp. 67–84, 2019.

[17] S. M. Ko, C. J. Kim, H. Jung and C. Cho, "Neural sign language translation based on human keypoint estimation," *Applied Sciences*, vol. 9, no. 13, pp. 26–83, 2019.

[18] D. Guo, W. Zhou, A. Li, H. Li and M. Wang, "Hierarchical recurrent deep fusion using adaptive clip summarization for sign language translation," *IEEE Transactions on Image Processing*, vol. 29, no. 1, pp. 1575–1590, 2020.

[19] S. D. Stauffer, M. Abessolo, G. Zecca and J. Rossier, "French-language translation and validation of the protean and boundaryless career attitudes scales: Relationships to proactive personality, career adaptability, and career satisfaction," *Journal of Career Assessment*, vol. 27, no. 2, pp. 337–357, 2019.

[20] N. Arivazhagan, C. Cherry, I. Te, W. Macherey, P. Baljekar *et al.,* "Re-translation strategies for long form, simultaneous, spoken language translation," in *ICASSP 2020-2020 IEEE Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP)*, Barcelona, Spain, pp. 7919–7923, 2019.

[21] A. Panayiotou, A. Gardner, S. Williams, E. Zucchi, M. Mascitti-Meuter *et al.,* "Language translation apps in health care settings: Expert opinion," *JMIR mHealth and uHealth*, vol. 7, no. 4, pp. e11316, 2019.