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Technology Solutions for Interpreters: the VIP System

Soluciones tecnológicas para intérpretes: el sistema VIP

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Abstract: Interpreting technologies have abruptly entered the profession in recent years. However, technology still remains a relatively marginal topic of academic debate, although interest in developing tailor-made solutions for interpreters has risen sharply. This paper presents the VIP system, one of the research outputs of the homonymous project *VIP - Voice-text Integrated system for interPreters,* and its continuation (VIP II). More specifically, a technology-based terminology workflow for simultaneous interpretation is presented.
Keywords: Technology, interpretation, terminology, corpus compilation, glossary generation.
Resumen: Las tecnologías de la interpretación han irrumpido bruscamente en la profesión en estos últimos años. Sin embargo, este tema sigue ocupando un lugar relativamente marginal del debate académico, aunque el interés por desarrollar soluciones a medida para los intérpretes ha aumentado considerablemente. Este artículo se describe el sistema VIP, uno de los resultados del proyecto homónimo *VIP - Sistema integrado de voz-texto para intérPretes* y su continuación (VIP II). Más concretamente, se presenta un flujo de trabajo terminológico basado en la tecnología para la interpretación simultánea.
Palabras clave: Tecnología, interpretación, terminología, compilación de corpus, generación de glosarios.

INTRODUCTION

Interpreting as a human activity has resisted complete automation for various reasons, such as fear, unawareness, communication complexities, lack of tools tailored to interpreters' needs, interpreters' negative attitudes to technology, etc. (Mellinger and Hanson, 2018). However, interest in developing tailor-made solutions for interpreters has risen exponentially in recent years. Interpreters' attitudes to technology have also evolved lately. By contrast to the findings in the exploratory study conducted by Corpas Pastor and Fern (2016), technology is no longer viewed with so much suspicion or reluctancy. New generations of interpreters (whether digital natives or digital immigrants) seem to be ready to embrace technology (Kerremans *et al*., 2019; Corpas Pastor, 2020; Corpas Pastor and Gaber, 2020). In fact, nowadays there is a pressing need to develop tools and resources adapted to interpreters' needs.

This paper introduces a novel voice-text integrated system for interpreters. After a brief overview of the sharp rise in technology use in interpreting (Section 1), the core components of the VIP system are described in terms of research milieu, design, and main functionalities (Section 2). Then, a seamless workflow for terminology work is presented in Section 3. Special emphasis is placed on the various degrees of automation fostered by VIP: from automatic corpus compilation to glossary creation and practice. This is, to the best of our knowledge, one of the first computerised platforms specially designed to cater for the technology needs of interpreters (both professional and trainees).

1. TOWARDS THE 'TECH' REVOLUTION IN INTERPRETING

Evidence of technological change, led by advances in digital technologies, is all around us and the field of interpreting is no exception. With the advent of new technology, interpreters can work remotely, deliver interpreting in different modes (consecutive, simultaneous, liaison, etc.) and contexts (conferences, courts, hospitals, etc.), on many devices (phones, tablets, laptops, etc.), and even manage bookings and invoice clients with ease (Gaber and Corpas Pastor, 2020). This kind of disruptive technology is already shaping the future (and even the present) of the profession, although it remains a relatively marginal topic of academic debate.

However, recent years have witnessed a tremendous interest in language technologies and digital resources for interpreters. It is sufficient to mention the number of conferences and workshops on interpreting technologies that have taken place over the last three years: 'Workshop on Human-Informed Translation and Interpreting Technology' (HiT-IT, Varna, 2019), 'Preparing for Interpreting 3.0' (23rd SCIC-Universities Conference, Brussels, 2019), 'Translation and Interpreting 4.0 – New Ways in the Digital Age' (BDÜ, Bonn, 2019), 'Translation and Interpreting Technology Online' (Triton2021, online event), '3rd International Conference on Translation, Interpreting and Cognition' (ICTIC 3, Bologna, 2021), and the annual editions of the well-established conference 'Translating and the Computer' (TC), organised by AsLing (TC41, TC42 and TC43), with special sessions on technology for interpreters since 2017.

At a European level, there are some initiatives that aim at combining both research and practice, albeit at a very preliminary stage (Ramunas, 2020).[1] This is the case for two in particular: the Interpreters' Digital Toolbox Project, launched by the European Commission's Directorate-General for Interpretation,[2] which is an integrated interface (in progress) that will provide interpreters with reference material, glossaries and terminology; and the Knowledge Centre on Interpretation, a digital platform for exchanging knowledge and creating synergies among diverse communities with an interest in interpretation. In the same vein, the European Parliament has just begun to explore further the potential of automatic speech recognition and language technologies in order to provide an automatic transcription and machine translation service for

[1] Some related EC-funded projects (like AVIDICUS, SHIFT or IVY, among others), deal with the creation of audiovisual materials for interpreter training. While these projects have generated valuable results, they could be considered still rather fragmentary, limited in scope and barely interconnected.

[2] https://ec.europa.eu/education/knowledge-centre-interpretation/news/eu-host-paper-new-technologies-and-artificial-intelligence-field-language-and-conference_es (accessed: 28/7/2021).

parliamentary debates covering the 24 official languages used by the institution (Feder, 2020).

Besides these EU institutional initiatives, practitioners are increasingly calling for tools tailored to their needs and their new work environments (Fantinuoli, 2018b). In fact, voices from the profession already view technology literacy as a key asset for interpreters as well (Drechsel, 2019). However, despite these recent trends, technology growth and automation in the profession still appear rather limited and slow-paced. While language technologies have already had a profound transformative effect in translation, they have not yet led to a paradigm shift within the interpreters' "digital workplace", nor have they materialised in the technological turn advocated by Fantinuoli (2018b). In contrast to translators, interpreters have benefited significantly less from purpose-built language technologies tools to make their work more efficient and to foster their adaptation to an ever-changing global market.

In general, present-day tools for interpreters are very limited and rather unsophisticated. The speech technologies that support those tools are still far from perfect; the potential of other technologies and / or their integration in tools developed for interpreters remains almost unexplored; and the impact of technology on interpreting has not yet been systematically studied. Interpreters need to be equipped with tools which support new functionalities and can provide assistance during all phases of the interpretation process (both onsite and remote), including self-assessment and training. And yet studies on interpreting technologies are still in their infancy (see, for instance, the two special issues edited by Pokorn and Mellinger, 2018, and Jiménez Serrano, 2019, as well as the papers in Rodríguez Melchor, Horváth and Ferguson, 2020).

A number of research gaps have already been identified in the literature, such as insufficient empirical research on the impact of interpreting-related technologies, a limited range of computer-assisted interpreting (CAI) tools, lack of technology contents in interpreting curricula, lack of quality-driven and user-driven studies of interpreting technologies, scarcity of process-orientated and cognitive studies on interpreting technologies, insufficient studies on the impact of technology and "hybrid" interpretation settings, etc. (cf. Costa *et al*., 2018; Braun, 2019; Wang and Wang, 2019; Mellinger and Hanson, 2019; Mellinger, 2019; Defranqc and Fantinuoli, 2021, among others).

Several attempts to meet interpreters' needs have been developed, mainly CAI tools, but they are rather modest in terms of the support they provide. Nowadays, CAI tools basically encompass terminology management tools, corpora, and note-taking applications (for an overview, see Corpas Pastor, 2018; Fantinuoli, 2017 and 2018a; and Braun, 2019). However, there are almost no comprehensive terminology tools to assist interpreters during interpretation or in the follow-up of interpreting assignments, nor can they be fully integrated in the interpreter's workflow. There is a severe lack of purpose-built tools that fulfil interpreters' needs and requirements. Most existing CAI tools do not cater to interpreters' requirements nor economic, sociotechnical and market challenges, neither do they take into account gender, cognitive or behavioural features. State-of-the-art tools suffer from further limitations in terms of platform-dependency, cross-platform access problems, integration and interoperability issues, low precision and recall, low degree of automation, lack of multiple format exchange, absence of robust cross-lingual Natural Language Processing (NLP) methodology and speech technology, among other issues.

In addition, different types of CAI tools present specific problems. For instance, terminology tools usually require manual lookup when searching for terminological data, which can be time-consuming and distracting for interpreters while they are performing an activity that requires concentration and rapid information processing. Although initial empirical studies on the use of CAI tools seem to support the idea that interpreters in the booth may have the time and the cognitive ability to manually look up specialised terms (Prandi, 2018), the automation of these queries would undoubtedly represent a step forward in reducing the additional cognitive effort needed to perform this human-machine interaction. In addition, terminological tools do not integrate other desirable functionalities such as (bilingual / multilingual) term extraction or corpus management. A notable exception is InterpretBank, a terminology tool which includes an automatic speech recognition (ASR) system, as well as the EU-BRIDGE EC-funded project.[3] This is a step towards automating querying systems of terminology tools and providing interpreters with numerals, terms and named entities, although it still required manual population of the terminological database before its use.

Corpora also present shortcomings, since they are not based on authentic interpreting, but rather on parallel corpora of translations, and they do not usually contain an aligned oral component. Few collections of interpreting data are available and the amount of data collected is too modest (to the best of our knowledge there are no such corpora of more than 250,000 tokens in Europe). The focus also tends to be too narrow and with a strong bias in favour of simultaneous interpreting from the European Parliament, as the data is freely available, which makes for unrepresentative data. Lastly, transcription of spoken data for corpus compilation is also a time-consuming process that would benefit from advances in ASR. The same applies to note-taking applications which largely rely on ASR and other speech technologies. Although these CAI tools are reported to be useful for consecutive interpreters, enhancing performance by turning consecutive interpretation into new hybrid interpretation modes (SimConsec and SightConsec), the benefits are still very limited due to the technical limitations of state-of-the art ASR and speech synthesis. For instance, even the latest speech technologies are far from performing optimally when it comes to handling speakers' disfluencies and accents or the automatic identification of named entities from speech, to name but a few of many issues.

Finally, applications used for interpreting training (computer-assisted interpreting training (CAIT) tools) have evolved from simple collections of resources to fully-fledged 3D virtual learning environments (*e.g.*, IVY 2011-2013 and EVIVA 2013-2014).[4] However, existing e-learning environments exclusively provide simulations for training that, apart from lacking a sense of grounding, immediacy, and presence, do not integrate corpus-based oral exercises to enable interpreters to practice domain-specific terminology and phraseology, nor do they detect

[3] https://www.eu-bridge.eu/

[4] More information on these two projects can be found at: http://www.virtual-interpreting.net

interpreting errors or generate feedback automatically, among other limitations.

2. The VIP system

A result of the central part of a research cluster on the use of technology in interpreting, the VIP system provides an integrated platform of various functionalities, tools and resources intended to enhance practitioners' performance (Corpas Pastor, 2020, 2021). This section will present a short overview of the rich milieu of synergies created around VIP, as well as the core components and main features of the system.

2. 1. Background

The VIP system is named after the acronym of the seminal project that initiated the research cluster (VIP I, henceforth): *VIP - Voice-text Integrated system for interPreters* (ref. no. FFI2016-75831-P, 2016-2020).[5] At the time of the submission (2016), interpreters' work still relied largely on traditional or manual methods, with little or no reliance on technology. Thus, our main aim was to implement a novel text-speech integrated system for interpreters, which was inspired by the translation environment tools in place.

Since then, a series of projects on interpreting-related technologies have followed. These projects revolve around technology along three main dimensions: (1) technology to aid an interpreter's performance; (2) technology in interpreting training curricula; and (3) technology to provide automatic interpreting services. Digitalisation, automation and technologisation are the key concepts that lie at the root of this research cluster on interpreting-related tools and resources.

VIP is the first open-source, purpose-built integrated system designed to fulfil interpreters' needs and requirements, and it is intended to provide support to both practitioners and trainees. It is also the first fully-fledged system to incorporate terminology tools that integrate (monolingual / bilingual) term extraction, corpus compilation and corpus management, while also allowing automatic glossary query and

[5] For further information on the projects mentioned, please visit the LEXYTRAD website at http://www.lexytrad.es/en/research/projects/

automatic identification of named entities (NEs) and numbers, among other desirable features mentioned in the literature.

So far there have been two versions of the system (1.0 and 1.1). VIP v.1.0 is the main output of the first project of the cluster (mentioned above), which was designed to boost interpreters' performance. VIP v.1.1. is the current, on-going version of the system (see section 2.2). It incorporates some of the improvements and new features envisaged in the continuation projects mentioned below.

Voice-text integrated system for InterPreters: Proof of Concept (ref. no. E3/04/21, 2021-2022) is a knowledge transfer project that seeks to assess the maturity of the VIP technology and to evaluate the system as an end product in terms of usability, effectiveness, security, and robustness. *VIP II - Multi-lingual and Multi-domain Adaptation for the Optimisation of the VIP system* (ref. no. PID2020-112818GB-I00, 2021-2025) is a research project that aspires to better accommodate the needs and requirements of interpreters. VIP II explores key under-researched areas (*e.g.*, ASR, multimodal corpora, cognition, human-machine communication), in order to develop an improved version of VIP with better features and more language pairs, domains, interpreting modes, modalities, scenarios, and so on. Finally, a recently granted project within this first batch will use Artificial Intelligence (AI) for POS (part-of-speech) tagging and NER in order to integrate French as part of the corpus functionalities of the VIP system (*Optimisation and multilingual adaptation of the Module on corpus for integrating French into the VIP system*, French Embassy in Spain, 2021-2022).

The second group of projects in the cluster focuses on undergraduate and postgraduate training as a means to foster autonomous learning, technology adoption, automation of processes, and technological literacy. They include teaching projects, postgraduate training programmes, and networks of various kinds. *INTERPRETA 2.0: application of ICT tools for the teaching-learning process of interpreting* (ref. no. PIE 17-015, 2017-2019) studies computer-assisted interpreting technologies and digital resources in the classroom. Two other networks examine the impact of the use of technology among professionals and trainees, with a view building bridges between industry and academia. (*Training Network on Language Technologies for Interpreters,* ref. no. EUIN2017-87746, 2017-2020; and *Research network INTEC: Interpreting and New Technologies,* ref. no. D5-2021_03, 2021-2022). The remaining two projects go down the same road. NLP, technology, translation, and interpreting appear strongly intertwined as well in *Application of Advanced NLP Techniques to the Field of Translation and Interpreting Technologies* (ref. no. EQC2018-004572-P, 2018-2020). Also worth mentioning here is the first *European Masters' in Technology for Translation and Interpreting* (ref. no. 599287-EPP-1-2018-1-UK-EPPKA1-JMD-MOB, 2018-2024), where graduates from mixed backgrounds (*e.g.*, Computer Science, Translation and Interpreting, Linguistics, NLP) study the impacts of technology use in the sector and carry out research to meet present and future needs of practitioners.

Finally, establishing the feasibility and impact of achieving full automation in real interpreting scenarios is the common thread in the remaining two projects of the cluster. Their main aim is to provide machine interpretation services in certain contexts (mainly community interpreting) through the use of various computational models, neural networks, AI, and NLP techniques. To this end, an app has been implemented that (a) enables effective communication between nurses and patients prior to emergency medical treatment, and (b) automatically generates trilingual triage reports. It has been carried out in the framework of a multimodal automatic speech-text-speech project (*Multilingual dialogue systems using neural networks for apps in the healthcare domain: the triage (Spanish-English / Arabic),* ref. no. UMA18-FEDERJA-067, ERDF, 2019-2021). In the same vein, the MI4ALL project (*Machine Interpretation for All Through a Deep Learning API*, ref. no. UMA-CEIATECH-04, 2020-2022) uses AI techniques and big data to create a prototype automatic interpretation software platform envisaged for the public services in general (including, but not limited to, hospitals, general practice, the police, etc.).

2. 2. Core components

VIP is a web portal that comprises an open catalogue of interpreting-related tools and resources (Component A) and a suite of platform-integrated functionalities to assist interpretation at all phases: preparation, delivery, training, and life-long learning (Component B).

Component A is a relational database management system (RDBMS) that uses Structured Query Language (SQL) to access the catalogue database. It is an open, interactive catalogue, as users can suggest new tools and resources, or report any issues. The VIP catalogue includes (i) computer-assisted interpreting (CAI) tools and resources: terminology management tools (*e.g.*, InterpretBank, Boothmate, OneClick Terms), note-taking devices (*e.g.*, Evernote, Notability, Livescribe), speech-to-text (*e.g.*, Speak it!, Otter AI, SpeechPal); (ii) remote interpreting (RI), i.e., cloud-based systems like Kudo, Interprefy or Headvox; (iii) machine interpretation (MI), such as Ambassador, VoiceTra and Pilot Speech Translator; (iv) computer-assisted interpreting training (CAIT) resources (*e.g.*, ORCIT, Speechpool, DG Interpretation) and virtual platforms (*e.g.*, IVY, Melissi VIS, Virtual Interpreting Environment); as well as (iv) other resources (unit converters, terminology extraction tools, voice recording, text to speech systems) that can also aid the interpreting process with special focus on corpus tools (Strand, Sketch Engine, ReCor, etc.).

The catalogue allows users to perform advanced searches and feature-based comparisons. See Fig. 1 for a screenshot of the catalogue within which RI systems are searched for by users according to some initial parameters set up by the user: platform or operating system (‘web’), languages supported (‘multi-language’) and type of licence (‘commercial’). The results are then compared on the basis of some desired features (also selected by the user): for conference organisers (‘Wifi supplied by VIT company’), individual clients (‘recodings, speech recognition’) and language service providers or LSPs (‘schedule interpreter in advance’, ‘interpreters in demand’); as well as brandability issues (‘possibility to incorporate brand logo’) and interpreter management system in place (‘possibility to generate invoices, pay interpreter, speed test’). The query page retrieves nine results of cloud-based interpreting systems which are then compared regarding the whole set of features available or only the ones selected (as in the case illustrated below).

	Headvox	Interprefy	Kudo	Linguali	Boostlingo	SAVD	Zoom	Olyusei app	ZipDX
Features for conference organisers									
Wi-Fi supplied by VIT company	✗	✗	✗	✓	✗	✗	✗	✗	✗
Features for individual clients									
Recordings	✓	✗	✓	✓	✓	✗	✓	✗	✓
Speech recognition	✗	✗	✗	✗	✓	✗	✓	✗	✓
Features for LSPs									
Schedule interpreter in advance	✓	✓	✓	✓	✓	✓	✗	✓	✗
Interpreters on demand	✗	✗	✓	✗	✓	✓	✗	✓	✗
Brandable									
Incorporate brand logo	✗	✗	✓	✗	✓	✗	✗	✓	✗
Interpreter Management Systems									
Generate invoices	✗	✗	✓	✗	✓	✗	✗	✗	✗
Pay interpreter	✗	✗	✓	✗	✓	✗	✗	✗	✗
Speed test	✓	✓	✓	✗	✓	✗	✗	✗	✗

Fig. 1. RI systems compared (VIP catalogue screenshot).

Component B is a multifunctional platform (MFP) that integrates various functionalities and technologies. Initially, VIP consisted of three different modules (v. 1.0). *Module I* was designed to be used in the preparation for an interpreting assignment. It comprised five main functionalities: automatic corpus compilation and management, glossary creation and management, named entity recognition (NER), and automatic text summarisation (for automatic domain survey). *Module II* was intended to be used when delivering an interpreting job (mainly for consecutive and bilateral modes). It included automatic note-taking, neural-based machine translation (MT), and glossary query. *Module III* was primarily designed for training and life-long learning purposes. It interacted with modules I-II and included a training module with exercises that are automatically generated (anticipation, glossary practice, numbers, sight-translation); and an experimental system with symbols for practising note-taking, based on ASR, AI and NLP techniques.

Both components were assessed in terms of performance and user satisfaction over the course of the initial project (VIP I). Internal evaluations of the system prompted us to explore new integrations and optimisations. External evaluations were also performed by professional interpreters and trainees (semi-professional interpreters and student interpreters) over 2019 and 2020. While internal and external evaluations of the tool showed very good results in general (4 out 5, in a Likert scale), the findings also pointed out to the existence of areas in need of further research (*e.g.*, ASR, multimodal corpora), functionalities that should be improved (*e.g.*, note-taking, machine translation), new integrations, new desired features, reorganisation of existing ones, and the need to introduce more languages and more language pairs, etc. (cf. Corpas Pastor, 2020).

Some of the novelties, changes, and suggestions (stemming from intrinsic and extrinsic assessment of the system) have already found their way into the current version. For better usability the structure in modules (I-III) has been replaced by a new distribution into "families" or sets of functionalities in VIP II source code. Version 1.1 is already organised in this way: (i) *Corpus functionalities*, (ii) *Glossary functionalities*, (iii) *Complementary functionalities*, and (iv) *Training functionalities*. These grouped functionalities are intended to provide support to interpreters and interpreter trainees / trainers. Figure 2 provides a diagram that illustrates the conceptual representation of the components and subcomponents of the VIP system as they stand at present.[6]

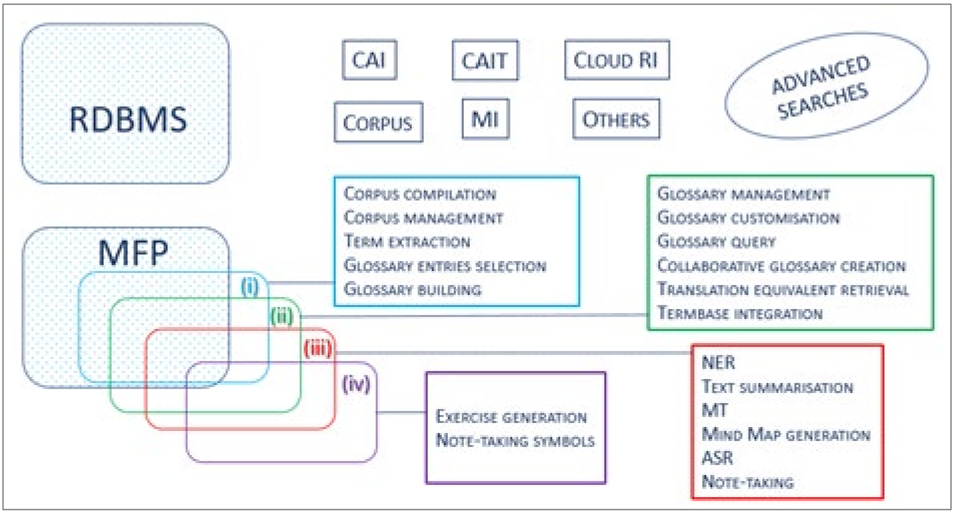


Fig. 2. VIP system architecture (v. 1.1.).

Corpus functionalities include former Module I and some of the new functionalities that will be implemented in VIP II: corpus renaming, merging and splitting; oral and multimodal corpus compilation and management; manual import of resources for corpus compilation through URL pasting; automatic deduplication and non-text filtering (*e.g.* boiler-plate removal); export of results in .xl format (n-grams, patterns, frequent words); and semi-automatic alignment of parallel corpora.[7] Other technical improvements are achieved by having direct access to CQP[8] and enlarging the number of document formats supported (.txt, .doc, .docx, .ppt, and .pdf).

[6] A video showing the main functionalities of VIP and various tutorials can be accessed from the URL: https://www.lexytrad.es/VIP/videos_en.php
[7] On the methodology used for automatic transcription of oral documents, see Gaber, Corpas Pastor and Omer (2020).
[8] CQPweb is a web-based graphical user interface (GUI) for the Corpus Query Processor (CQP). In VIP II, corpus functionalities will no longer operate through the CQPweb interface (http://cwb.sourceforge.net/cqpweb.php), but directly to CQP on the server (http://cwb.sourceforge.net/index.php) for more interoperability and flexibility.

Glossary functionalities integrate Glossary management (formerly in Module I) and Glossary query (formerly in Module II). The new functionalities planned for this set are the following: management and query of synonyms; merging, splitting, and sharing of glossaries; collaborative glossary creation; customisation of glossary directionality and languages; increase of search options per selected languages; and optimisation of MT candidate translation equivalents (by improving MT engines, training neural networks, etc.). Further integrations are also performed: the comparable corpus and parallel corpus functionalities are integrated to enhance machine translation outputs and retrieval of translation equivalents. At a later stage, IATE[9] will also be integrated to improve access to terminology resources and translation equivalents.

Complementary functionalities comprise NER (formerly in Module I), automatic text summarisation (Module II), automatic note-taking (Module II), and machine translation (Module II). Regarding named entity recognition (NER), a new functionality has been implemented to extract NER from whole corpora (not only from uploaded documents or pasted documents, as in VIP I). New extraction methods are currently being reviewed and tested to enhance the system and achieve better precision and recall. Optimisations is also sought by pattern-filtering of named entities (already implemented in v. 1.1.), by training the system with neural networks, and by incorporating post-processing techniques that achieve better results for integration of NER and Glossary functionalities. Automatic text summarisation will be optimised through better extraction techniques (synthesis) and integration with corpus and glossary functionalities (already in v. 1.1.). In addition, a new functionality to build mind maps automatically is envisaged to be included at a later stage. Problems detected with note-taking are mainly due to the technical limitations of the state-of-the-art ASR in place. In order to improve the system, research on ASR systems is crucial, as better voice recognition is needed (accent, background noise, disfluencies, etc.). Optimisation is also achieved by improving compatibility (different browsers and mobile devices)[10] and through

[9] https://iate.europa.eu/
[10] VIP I was optimised for Google Chrome.

integration with Glossary functionalities. Machine translation is another soft spot in VIP I. Integration with corpora is envisaged to obtain improved results for bilingual glossary (see above). MT will be further optimised by training (or fine-tuning) a deep learning (DL) neural network, following Chu and Wang's (2018) methodology.

Training functionalities encompass former Module III. Optimisation will be achieved through a wider choice of exercises in general and by programming difficulty scales. Research on ASR will also be instrumental in improving oral exercises with numbers and terms. A novel functionality to improve sight-translation exercises will be the new possibility to select the parallel corpora created or selected by users to generate exercises. For this reason, integration with *Corpus functionalities* is also envisaged. Exercises with symbols to practice note-taking will also benefit from optimisation by DL neural networks and increased browser compatibility Users will also be allowed to upload their own symbols to practice. This new functionality will require reviewing and testing AI methods for better image recognition.

2. 3. Research approach

The changes and novel features mentioned in 2.2. are compatible with other findings in VIP I which suggested that: (i) it is possible to provide interpreters with more efficient language technologies which can be seamlessly integrated in their workflow; (ii) our system can be ported to new languages and domains; (iii) the approach adopted needs to be multi- and interdisciplinary, user-orientated, and human-centric; and (iv) it is necessary to adapt to new interpretation scenarios in terms of technology uptake, real needs, and degree of automation in a rapidly changing world.

The aforementioned results also shaped the research approach adopted for the continuation project of the cluster (VIP II). Thus, in order to improve the system and users' experience, we have set up two overarching objectives: (a) advancing interpreting technology from a number of disciplines, and (b) advancing these disciplines, by resolving the problems and limitations encountered. Fig. 3 illustrates our research strategy and how the various disciplines interact among themselves and with the stakeholders. This involved reordering subcomponents and functionalities, which has contributed to optimising the system in VIP II. New functionalities or subcomponents are to be added to each set in the course of the on-going project. Finally, technical changes and new integrations will be performed among (sets of) features and in relation to external resources. This will also enhance the system performance. Further degrees of optimisation will be achieved by multilanguage and multi-domain adaptation.

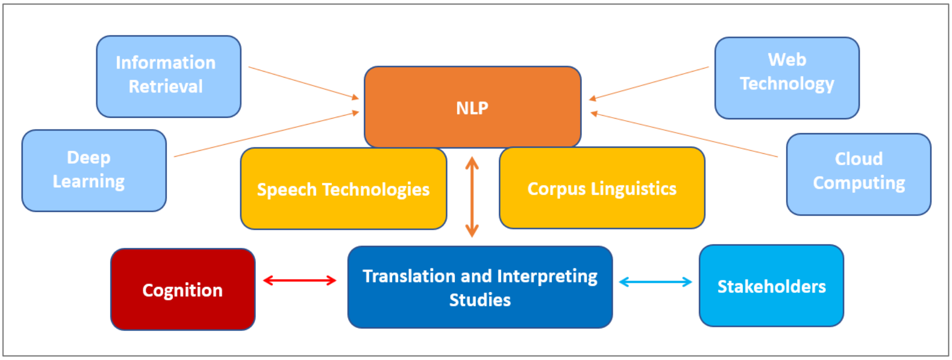


Fig. 3. VIP II research strategy.

We are confident that the VIP system can be ported to new languages and more specific domains. VIP was initially designed for the language pair Spanish-English. Adding more languages has been a unanimous suggestion for improvement in all external evaluations. In VIP II the system will also support French, German, Italian, Chinese and Arabic. These new languages have been chosen on the basis of interpreters' suggestions, data about the most spoken languages in the world (Ethnologue, 2020),[11] tourism and migration fluxes in Spain (INE),[12] and Pielmeier and O'Mara's (2020) latest report. Enlarging the number of languages (and language pairs) supported by the system will result in new technical requirements that the system must meet at different levels. Broadly speaking, a series of changes to the user interface will be necessary, in some cases even involving a redesign of

[11] https://www.ethnologue.com/guides/ethnologue200 (accessed: 2(12/2020).
[12] http://www.ine.es/ (accessed: 2/12/2020).

the visual aspect of the tools. Changes will include more language selection options, more columns in glossary tables, multiple directionality options and language combinations, and compatibility with different character sets and text direction (Chinese and Arabic). Settings and functionalities will have to be adapted for better customisation, language choice and usability. It will also be necessary to redesign and adapt the programming of the system in terms of compatibility since the inclusion of new languages implies the appearance of new characters, accents, and dieresis. The system will have to be able to process a greater number of text encodings. This is particularly important for those functionalities that enable users to upload and / or import their own files.

Finally, and most importantly, including more languages is a challenge at the level of language models and algorithms. These necessary changes will affect different functionalities and subcomponents. For instance, new models will be integrated and / or trained to accommodate the new languages (pre-processing, POS tagging, corpus compilation and management); new multilingual DL models compatible with the new languages and language-independent algorithms need to be assessed for improved performance and integrated or fine-tuned (especially for NER, MT and automatic summarisation); and new ASR models need to be fine-tuned and / or integrated for all the new languages supported. The tools used in VIP1.0 for synthesis and speech recognition use the WebSpeech API that is integrated into the Google Chrome browser. Although the performance is adequate, it limits the compatibility of the system in general and does not support all the new languages. In addition, specific word embeddings and language coding techniques will be applied to train multilingual DL learning models. These techniques offer good results in developing NLP models for different purposes by fine-tuning both supervised (parallel corpus) and unsupervised (monolingual corpus) data even for languages with few training resources.

Multi-domain adaptation will also imply changes in the system at different levels: interfaces will be redesigned, and new options will be included for improved customisation according to new topics, domains, interpreting contexts and scenarios, etc. Domain-specific resources collected will be integrated into the system (corpus functionalities and glossary functionalities); and contextualised word representations and representation techniques (such as Peters *et al*., 2018) will be used to achieve improved performance for specific domains. From these contextualised word representation techniques, both domain-specific and general corpus resources will be used for fine-tuning by training specific models for certain tasks. It will also be necessary to establish mechanisms for the classification of texts and topic modelling to establish the domain of the input data and select the appropriate model for each case (Chu and Wang, 2018). This will improve the system performance, save time, and provide a higher level of automation. Some examples of domain-related new implementations are external query of terms in domain-specific resources, web-crawling through domain-specific search engines, adaptation of MT models to specific domains, etc.

3. Terminology work for simultaneous interpretation

Terminology work is considered in the literature an essential part of any interpreting assignment (Fantinuoli, 2017, 2018c; Krsnik, 2017; Costa *et al*., 2018; Xu, 2018; Fantinuoli and Prandi, 2018; Gaber *et al*., 2020). Very often interpreters are faced with a highly specialised topic and have almost no time to prepare domain-specific terminology, specialised phraseology and other multiword units or lexical bundles that characterise a given jargon. Very rarely are interpreters sent reference documents, spoken speeches, or any other oral resources well in advance. This is especially the case in simultaneous and conference interpreting, for which preparation is often time-consuming and even stressful.

In this section we will showcase a novel, automated procedure to prepare for an interpreting assignment using VIP (v. 1.1). To this end, we have simulated a preparatory phase (advanced preparation) for a blind interpreting assignment[13] on “active volcanos”. We have chosen this topic because volcanology conferences are very popular within the scientific community. A cursory look at Conference Index shows up to

[13] Following Gaber *et al*. (2020: 267-8), a “blind interpreting assignment” refers to a situation in which the interpreter is provided only with the conference topic, without any further information.

45 international conferences scheduled within the next three months (October-December 2021).[14] Volcanic emergencies also tend to be of much interest for the layman and the mass media alike. By way of illustration, let us mention the recent eruption at La Palma (Canary Islands, Spain),[15] that is attracting worldwide attention.

In the context of a blind interpreting assignment, interpreters will undoubtedly benefit from a fast and efficient workflow that enables them to compile quality glossaries from scratch. VIP allows the automation of various stages of terminology preparation: from corpus compilation to automatic glossary creation and postediting of MT translation equivalent candidates, including automatic generation of glossary exercises.

3. 1. Automatic compilation of VULCANOCOR

Manual compilation of corpora is a notoriously time-consuming process. By contrast, automatic corpus compilation can save precious time when preparing for an interpretation assignment. VIP provides interpreters with corpus functionalities that allow for (semi-)automatic corpus creation on any domain. Within *Monolingual corpus management*, users can select *Semi-automatic corpus compilation*, choose the language (Spanish or English in v. 1.1.), and then enter a simple or a Boolean query sequence. The seed words used will retrieve a set of related webpages that can be selected automatically, limited in number, or, else, inspected individually and then selected manually.

In order to illustrate automatic compilation of a bilingual comparable corpus on volcanology, we have created two monolingual subcorpora in a linear fashion: Volcano1 (Spanish) and Volcano2 (English). Corpus comparability has been facilitated by selecting the same search engine (level 1), retrieving the same number of documents (Select all), and entering the same set of equivalent seed words: *volcán*, *erupción*, *lava*, *caldera* in Spanish (ES); and *volcano, eruption, lava, caldera* in English (EN). Fig. 4 illustrates automatic corpus compilation of the English subcorpus (Volcano2).

[14] https://conferenceindex.org/conferences/volcanology (accessed: 20/9/2021).
[15] Since the eruption began on 19 September 2021, it has increased in intensity and prompted the evacuation of thousands of residents and tourists.

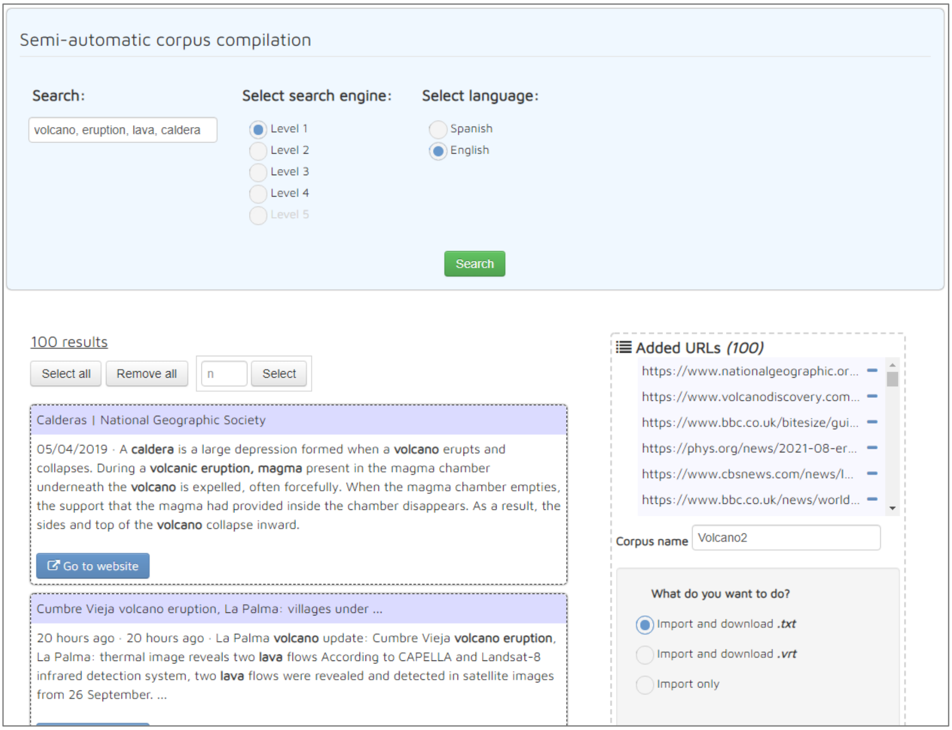


Fig. 4. Automatic compilation of the English subcorpus.

Depending on the processing capacity of the desktop or laptop used, as well as the speed of the Wi-Fi connection and the number of documents selected, the time spent on corpus compilation can take typically from 1 to 5 minutes. Users can opt to import the corpus to the VIP system and download the files in *.txt* or *.vrt*, or just to import the corpus to be queried straightaway. It is also possible to create one file with all the information (all .txt files together) or else create one file per web (our choice in this case study).

The resulting Spanish subcorpus (Volcano1) comprises 98 documents, 222,865 running words or tokens, and 20,210 types (type / token ratio, TTR: 11.02). A similar automatic compilation process to create the English subcorpus (Volcano2) retrieved the same number of documents (98), but the size was much smaller: 149,717 running words (15,785 types; TTR: 9.48). In a second step, the English subcorpus was increased by 72,230 tokens more for better balance. Table 1 shows the final size and composition of VULCANOCOR.

	language	docs.	Types	tokens	TTR
Volcano1	ES	98	20,210	222,865	11.02
Volcano2	EN	112	22,167	221,947	10.01
VULCANOCOR	ES-EN	210	42,377	444,812	10.49

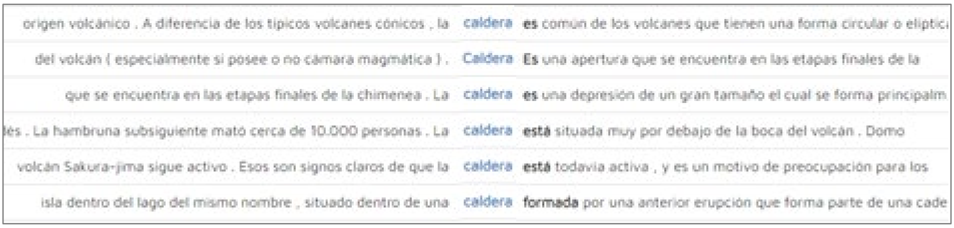
Table 1. Size and composition of VULCANOCOR.

To ensure comparability further, a list of frequent terms is extracted and cross-examined. Table 2 shows the ten most frequent single-noun terms in both subcorpora. The number of occurrences (tokens) and percentage among all nouns in the corpus are also indicated after each term. There is a coincidence of 90% of top ten terms in both corpora. However, the percentage could be higher if we consider that the two missing terms occur within the 30 most frequent ones in both corpora: the term *cone* (ES *cono*) has a frequency of 174 tokens (0.4%) in the English subcorpus and *domo* (EN *dome*) appears 27 times in the Spanish one (0.5%).

Volcano1			**Volcano2**		
volcán	2,022	4.85%	*eruption*	1,955	4.46%
Erupción	1,642	3.93%	*volcano*	1,847	4.22%
lava	1,388	3.32%	*Lava*	1,424	3.25%
ceniza	520	1.24%	*caldera*	619	1.41%
magma	284	0.68%	*earthquake*	502	1.15%
colada	351	0.84%	*Flow*	463	1.06%
cráter	150	0.36%	*Ash*	401	0.92%
Caldera	128	0.31%	*magma*	365	0.83%
cono	117	0.28%	*crater*	332	0.76%
Terremoto	85	0.2%	*Dome*	174	0.4%

Table 2. Top ten terms in the Spanish and English subcorpora.

Once the bilingual corpus has been checked for comparability and quality, it can be exploited in various ways. For instance, VULCANOCOR can be used to meet the information needs of interpreters, like any other reference material. See concordances (right-sorted) for the lemma *caldera* in the Spanish subcorpus (Fig. 5).



origen volcánico . A diferencia de los tipicos volcanes cónicos , la	caldera	**es** común de los volcanes que tienen una forma circular o eliptic
del volcán (especialmente si posee o no camara magmática) .	Caldera	**Es** una apertura que se encuentra en las etapas finales de la
que se encuentra en las etapas finales de la chimenea . La	caldera	**es** una depresión de un gran tamaño el cual se forma principalm
ies . La hambruna subsiguiente mató cerca de 10.000 personas . La	caldera	**está** situada muy por debajo de la boca del volcán . Domo
volcán Sakura-jima sigue activo . Esos son signos claros de que la	caldera	**está** todavia activa , y es un motivo de preocupación para los
isla dentro del lago del mismo nombre , situado dentro de una	caldera	**formada** por una anterior erupción que forma parte de una cade

Fig. 5. KWIC concordance for caldera (Volcano1).

The KWIC lines also allow full-text pop-up displays. The text corresponding to the second concordance line above provides an encyclopaedic definition of the term:

> Caldera. Es una apertura que se encuentra en las etapas finales de la chimenea. La caldera es una depresión de un gran tamaño el cual se forma principalmente cuando ocurre una erupción, creando así una gran inestabilidad dentro de esta montaña rocosa por ausencia de un soporte y el suelo termina colapsando en el interior creando así una caldera. Hay que resaltar que no todos los volcanes tienen caldera.

VULCANOCOR can also be used to generate a domain survey. VIP includes automatic summarisation of corpus documents (all of them or a subset), with various levels of compression rate and word count per file. The resulting .txt files can be used as a domain survey and / or downloaded to be used recursively as a terminology-rich condensed corpus (see Fig. 6). Terms can be then extracted (manually or automatically) and stored, *e.g.*, *lava flow, eruption, vent, chamber, thermal emission, volcanic plume, caldera rim*, etc.

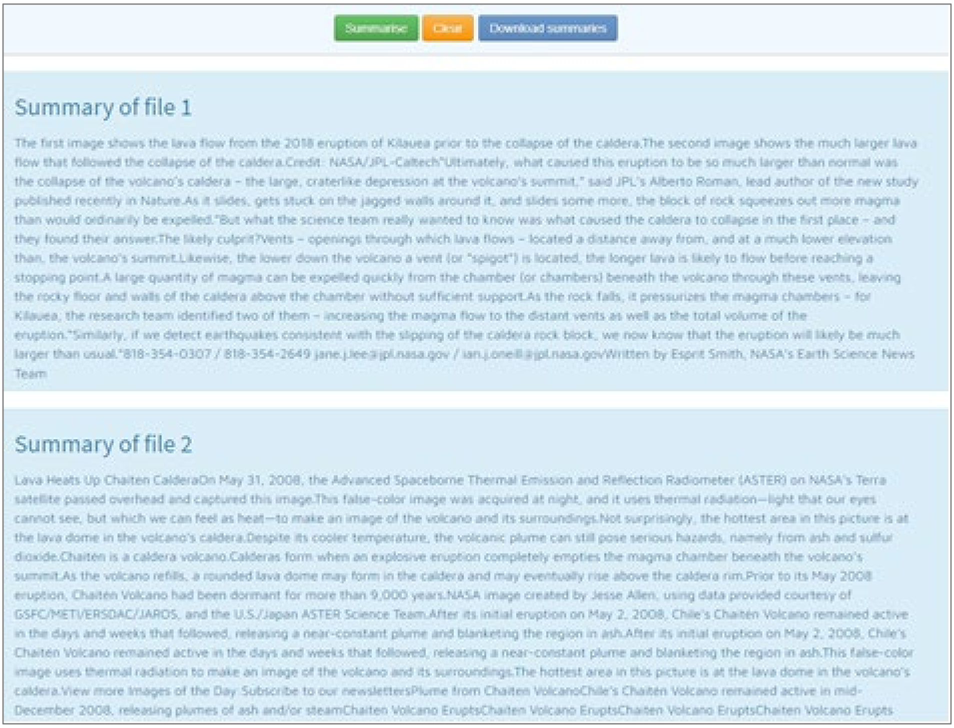


Fig. 6. VIP Automatic summarization.

3. 2. Automatic creation of VULCANOLEX

In this section we illustrate how to use the bilingual comparable corpora described in 3.1. to extract terms and create a bilingual glossary automatically. The process is quite straightforward. For single-noun terms, a frequency list can be generated from which users simply select with a click. The selected terms can be added to an existing glossary or to a new glossary created on the spot. Multiword terms and collocations can be selected in a similar fashion. First, various term-forming patterns can be queried in the corpus, either using empty POS (N + N, Adj + N, N + prep + N, N + *, etc.), or else with a given word as part of the pattern. The user simply clicks on the selected term candidates and adds them to the glossary. (See Figs. 7-8).

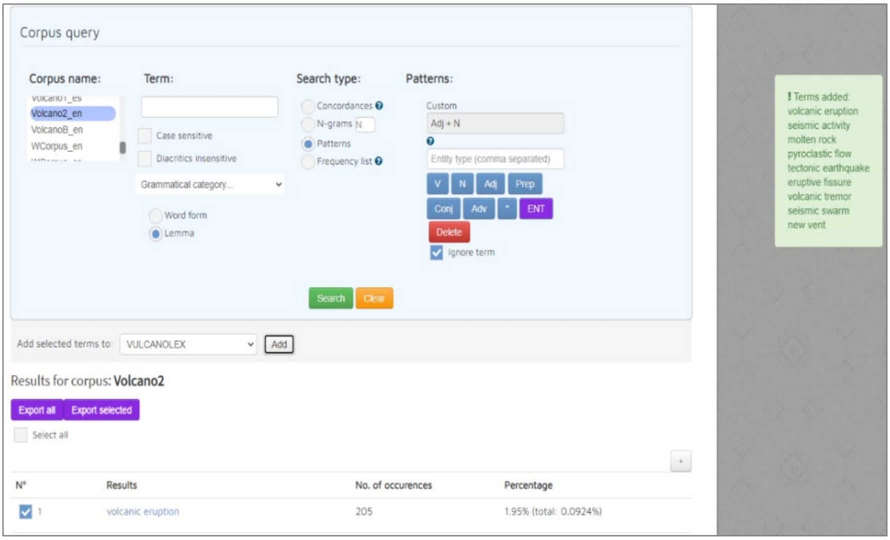


Fig. 7. Pattern extraction [Adj. + N] (Volcano 2).

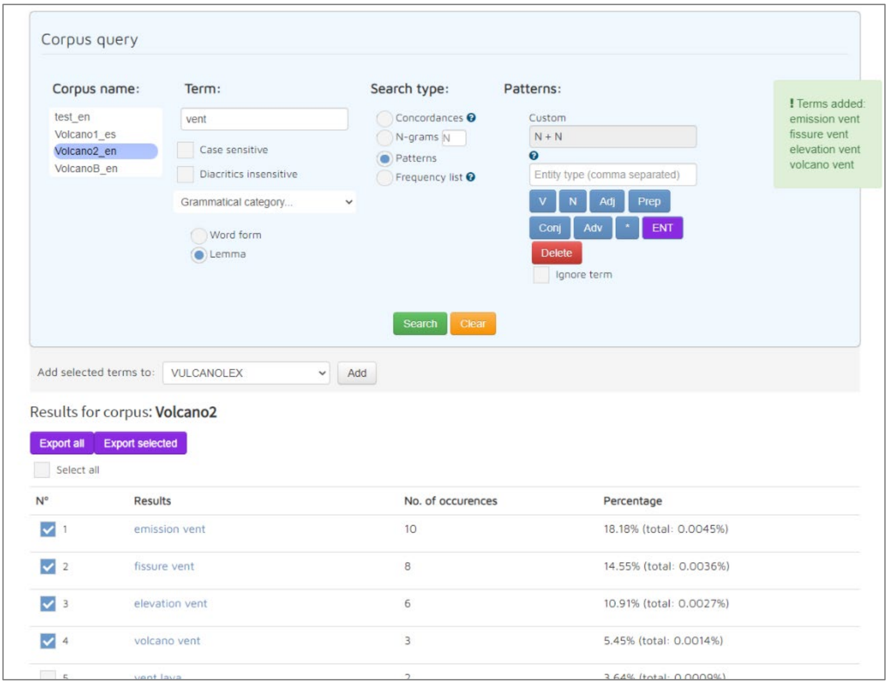


Fig. 8. Pattern extraction [N + N_vent] (Volcano2).

Lexical bundles can also be extracted automatically via N-grams (see Fig. 9). These sequences are particularly useful to identify specialised phraseology in the form of clusters, as a link between the term and the text (cf. Pontrandolfo, 2015). Interpreting domain-specific speeches is not only about acquiring expert knowledge and finding the right equivalent terms, but it is also a problem of rendering phraseological conventions and discourse conventions appropriately. Fig. 9 illustrate 5-grams with *lava* and selected sequences added to VULCANOLEX.

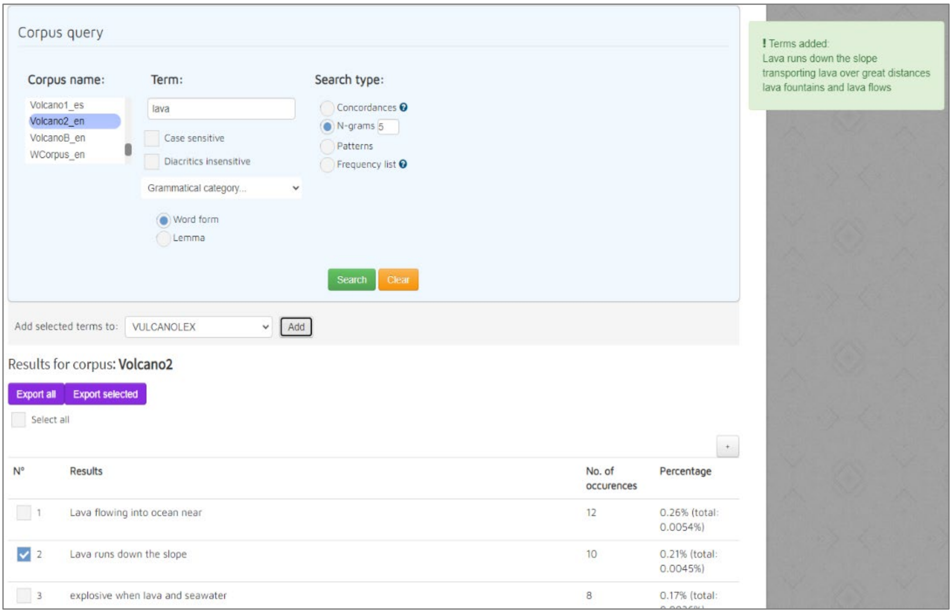


Fig. 9. Extraction of 5-grams containing lava (Volcano2).

Named entities (NEs) are a specific type of terms that identify real-world "objects", such as persons (Arianna Soldati), locations (Compton-Belkovich Volcanic Complex), organisations (American Geophysical Union), products (EarthChem), dates and numbers (1971), magnitudes (cubic kilometers, ck), etc. Within the Complementary set of functionalities, VIP includes named entity recognition (NER), the system that can retrieve NEs from a text or a corpus. It allows users to add selected items to a glossary (cf. Fig. 10). Results can be displayed visually within the text or, else, by means of a table of customisable tags.

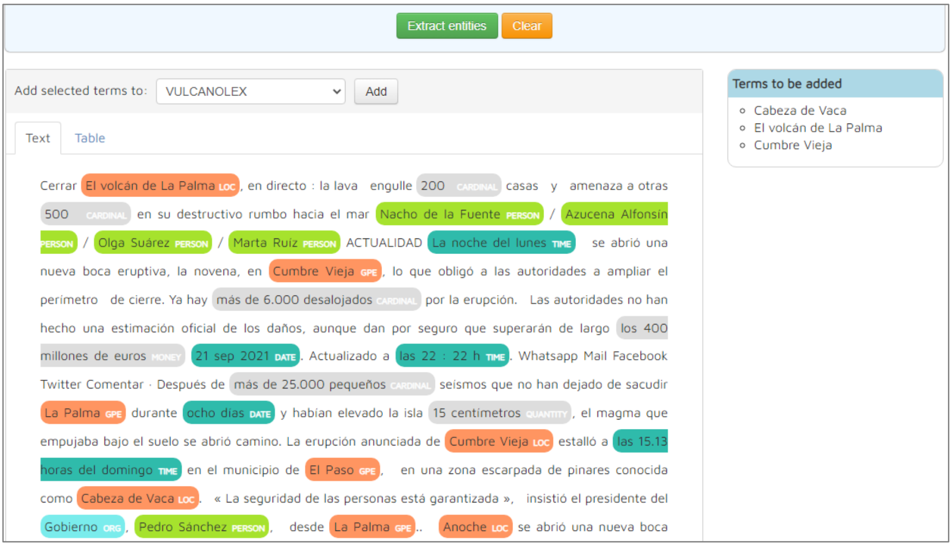


Fig. 10. NER output (text) screenshot (Volcano1).

Once the terms and any MWEs (multiword terms, collocations, lexical bundles, NEs, etc.) have been added, the glossary is ready to be edited. MT equivalents are provided automatically for users to change, validate or simply post-edit. External queries can be performed directly from search engines and other lexical resources, *e.g.*, on-line translation memories, machine translation systems, etc. (see Fig. 11). Entries can be deleted, added, edited and / or validated. Automatically generated glossaries can be exported to Excel files, reordered alphabetically, merged, and so forth.

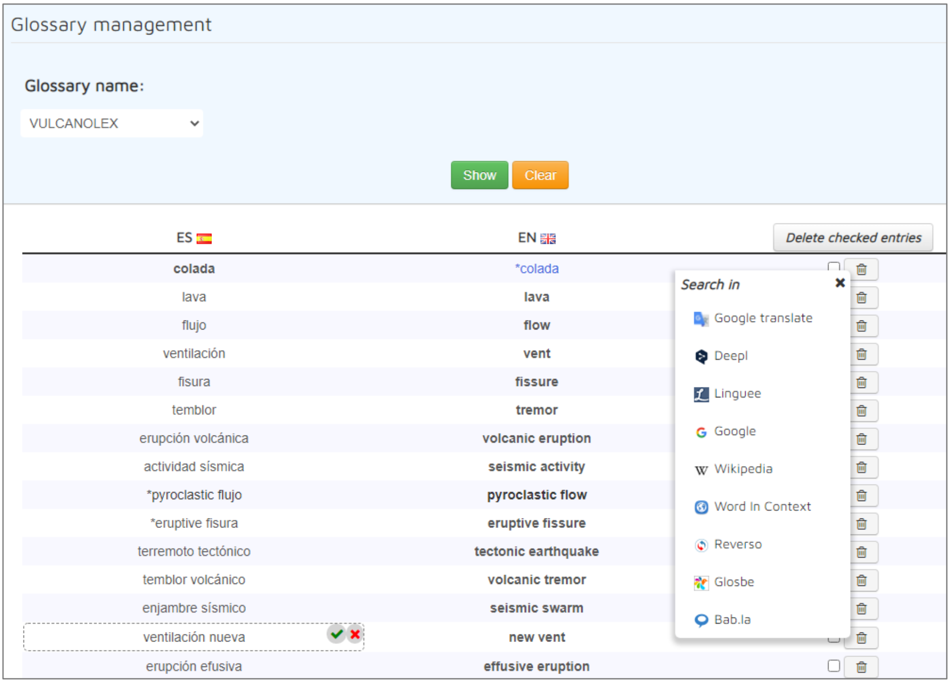


Fig. 11. Automatic generation of bilingual glossary.

Glossary entries selected from corpora appear in bold, as opposed to MT outputs, in order to aid interpreters in postediting and validation tasks. For instance, the Spanish term *colada* has been left untranslated by the VIP MT system. Possible translation equivalents can be found among the corpus-based selected key terms in English (*flow* and *lava flow*). A concordance search of the English subcorpus shows that both terms are possible, although *lava flow* appears to be more technical (see Fig. 12).

Size and Duration of Volcanic Eruptions May 10 , 2021 A **lava**	flow	from Hawaii 's Kilauea Volcano enters the ocean near Isaac Hale Be
of the caldera . The second image shows the much larger **lava**	flow	that followed the collapse of the caldera . Credit : NASA /
that the channel to the sea that has opened stops the **lava**	flow	, which widened to reach 600 metres at one point , from
of explosions and the release of toxic gases . " The **lava**	flow	has reached the sea at Playa Nueva , " the Canary Islands
m per hour eastwards . At the same time , the **lava**	flow	from the secondary fissure vent at the NW base of the cone
One of the most notable was the successful diversion of a **lava**	flow	and blanket at Mount Etna in 1992 . The flow was threatening
" The volume and shape of the 1991 - 1993 **lava**	flow	field at Mount Etna , Sicily " . Bulletin of Volcanology .
gradual evolution of the Holuhraun (or now called Nornahraun) **lava**	flow	field and compares it with the two largest lava fields erupted on

Fig. 12. KWIC concordance for flow (Volcano2).

Finally, glossaries (and corpora) can also feed vocabulary exercises designed for interpreters to practice. VIP can generate anticipation and fill-in-the-gap exercises, glossary-based quizzes, etc. The actual glossaries (and corpora) to be used are selected on demand, as well as the number of exercises to be generated and the language-pair configuration desired (American or British English). See Fig. 13.

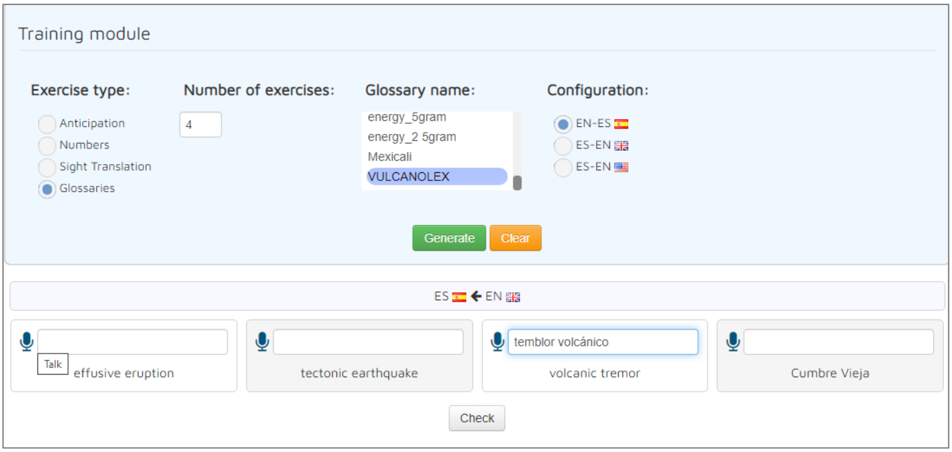


Fig. 13. VIP training module: glossary exercises.

Conclusions

Technology is beginning to play a highly important role in different interpreting modes and scenarios. While remote delivery is here to stay (especially after the COVID-19 pandemic), tools and resources needed by practitioners go beyond cloud-based videoconferencing systems. Automation within multilanguage-access services is not restricted to recent developments in machine interpretation or multilingual dialogue systems either. Automation, digitalisation, displacement, and virtualisation lie nowadays at the heart of human interpretation. Interpreting technologies are continuing to grow at a rapid pace and evolving in newer ways that we previously thought impossible.

It is well known that interpreters (especially in simultaneous mode) tend to be pressed for time when preparing for an interpretation job. Practitioners need to be equipped with adequate tools and resources that enable them to enhance their performance by saving time, automating tasks, and diminishing their stress levels and cognitive fatigue.

VIP is among the first pioneering platforms that provide interpreters with seamless technological support when working with topic-specific knowledge, developing domains, neology terms, synonym term pairs, variant spellings, and phraseological patterns, among the other challenges of their daily work.

Further multidisciplinary research is needed to pave this path. In this context, creating synergies between developers, practitioners, academics, and other stakeholders should be one of our first priorities.

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