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ЯЗЫКОВЫЕ БАРЬЕРЫ В МЕТАВСЕЛЕННЫХ: ВОЗМОЖНОСТИ НЕЙРОСЕТЕЙ ПРИ ПЕРЕВОДЕ

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Аннотация. Метавселенная – это общее виртуальное пространство, доступное пользователям из разных частей мира, представляющее собой платформу для взаимодействия. В метавселенной нет барьеров, возникающих в связи с географическим положением, времени в ней также не существуют, что обеспечивает беспрепятственное общение. Языковые барьеры внутри и между метавселенными – это существенные препятствия, которые мешают взаимодействию и сотрудничеству. Неспособность их устранения может перечеркнуть все преимущества метавселенных. В данной статье рассматриваются перспективы ликвидации языковых барьеров: применение нейронных сетей для перевода, а также использование технологии виртуальной реальности для облегчения многоязычного общения и понимания в иммерсивной среде, достигаемое с помощью перевода речи в текст в режиме реального времени, программного обеспечения для распознавания голоса, обработки естественного языка, интеграции с существующими службами перевода.

Ключевые слова: метавселенная, нейронные сети, языковые барьеры, машинный перевод, виртуальная реальность

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GENERAL QUESTIONS OF LINGUISTICS (PHILOLOGICAL SCIENCES)

Original article

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LANGUAGE BARRIERS IN METAVERSES: THE POWER OF NEURAL NETWORKS IN TRANSLATION

Abstract. The metaverse is a shared, virtual space, accessible to users worldwide, offering a platform for global interaction. The physical barriers of geographical location and time are non-existent, allowing for seamless connectivity and interaction. Language barriers within and between metaverses present substantial impediments to fluid interaction and collaboration. Failure to address this linguistic divergence can stifle the capacity of these digital arenas to facilitate collaboration, innovation, and shared experiences. This paper endeavours to explore a prospective resolution to these language barriers: the deployment of neural networks, also refers to the use of virtual reality technology to facilitate multilingual communication and understanding in immersive environments achieved thoughreal-time speech-to-text translation,

voice recognition software, natural language processing, integration with existing translation services.

Keywords: metaverse, neural networks, language barriers, machine translation, virtual reality

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Введение

The expansion of digital landscapes has led to the emergence of metaverses – intricate networks of interconnected digital domains, each exhibiting distinct attributes, and in many instances, employing unique languages. This proliferation of languages, previously limited to the confines of human societies and cultures, has extended its reach into these novel virtual territories. Consequently, a formidable challenge has been unveiled: the existence of language barriers within and between these metaverses. These barriers, indicative of the diversity inherent in these emergent digital spaces, simultaneously present substantial impediments to fluid interaction and collaboration.

In the terrestrial context, language translation has long served as a conduit between disparate cultures, engendering mutual understanding and cooperation. Nevertheless, within the scope ofmetaverses, its significance is considerably amplified. Given the existence of a myriad of unique languages, often subject to dynamic construction and evolution, the provision of effective communication among entities spanning various spaces is critical to the flourishing of the metaverses. Failure to address this linguistic divergence can stifle the capacity of these digital arenas to facilitate collaboration, innovation, and shared experiences.

This paper endeavours to explore a prospective resolution to these language barriers: the deployment of neural networks. Neural networks, a subset of artificial intelligence, have demonstrated exceptional capacity in the realm of language translation in our physical world. Their inherent ability to learn and adapt renders them particularly compelling within the context of the dynamic language characteristic of metaverses. This work aims to investigate the role and potential of neural networks in surmounting language barriers in metaverses, thereby contributing fresh insights into how artificial intelligence can enhance the development and evolution of our rapidly expanding digital expanse.

Исследовательские результаты и их интерпретация

The Metaverse and Language Barriers

The concept of the «metaverse» was first introduced to popular culture by science fiction author Neal Stephenson in his 1992 novel Snow Crash. Stephenson's metaverse represents an amalgam of physical reality and digital virtuality, creating a continuous, collective, multi-user environment that transcends the barriers of the tangible world. The metaverse is predicated on the convergence of several key technologies that facilitate multi-sensory interactions with virtual environments, digital objects, and individuals, including virtual reality (VR) and augmented reality (AR). These technologies allow for real-time communication, immersive user experiences, and dynamic interactions with digital artifacts [1, 2].

The current conceptualization of the metaverse encompasses a variety of social and immersive VR platforms, open-world video games, and AR collaborative spaces. The metaverse is a shared, virtual space, accessible to users worldwide, offering a platform for global interaction. Within the metaverse, the physical barriers of geographical location and time are non-existent, allowing for seamless connectivity and interaction [1, 2].

Several examples of metaverses that currently exist include:

1. Second Life is a virtual world where users can create avatars, interact with each other in a three-dimensional environment, and participate in a virtual economy by buying and selling digital goods and services.

2. Roblox is an online gaming platform where users can design their own games and virtual worlds, as well as play games created by other users.

3. A sandbox-style video game, Minecraft provides players with the opportunity to construct and explore block-based virtual worlds.

4. A blockchain-based virtual world, Decentraland allows users to buy, sell, and develop virtual real estate and interact with other users within the digital space.

5. Fortnite is an online game that pits players against each other in a virtual battle royale. Additionally, the game hosts virtual concerts and other events, providing a broad range of experiences for users.

Virtual worlds and metaverses have revolutionized the ways in which individuals connect and interact, providing opportunities for engagement that were previously unattainable. Users can create personal avatars, explore digital environments, interact with others, and participate in a diverse array of activities within these digital domains. As such, the metaverse represents a fundamental shift in the landscape of human interaction, communication, and experience [3, 4].

As a conception of a global and inclusive shared space, the metaverse is anticipated to host an abundance of languages, mirroring the linguistic diversity of its user base. This parallels the current state of the Internet, where content is crafted in a multitude of languages. Consequently, it is foreseeable that each and every language spoken in the physical world could have a potential counterpart in the metaverse, spanning widely spoken languages such as English, Mandarin, and Spanish, to regional dialects, and even extending to constructed languages like Esperanto.

The linguistic nature of the metaverse may be dictated by the type of interactions that occur within it. Given the multimodal channels of communication that metaverses are projected to support, both written and spoken forms of languages would likely be utilized. Furthermore, the metaverse could witness the birth of novel linguistic phenomena, such as digital dialects or a metaverse-specific vernacular, shaped by the unique attributes of digital spaces and cultures.

However, the issue of language barriers presents a significant obstacle within the metaverse. Due to the global and diverse disposition of these spaces, it is inevitable that users will confront languages that are alien to them. These barriers can impede communication, collaboration, and comprehension, thereby restricting the potential for global interaction and cooperation within the metaverse.

The repercussions of such language barriers could manifest in several ways:

1. Users might be unable to fully immerse themselves or reap the benefits of metaverse experiences if they lack understanding of the languages employed in those experiences. This could curtail user engagement and satisfaction.

2. Language barriers could precipitate the emergence of language-based communities within the metaverse, potentially leading to a fragmented metaverse landscape. This could restrict cross-cultural exchanges and reinforce pre-existing divisions.

3. If certain languages are favored over others in the metaverse – akin to the dominance of English on the present Internet – this could result in disparities in access to information, resources, and opportunities.

Neural Networks in Translation

The concept of neural networks has been explored since the 1940s, but the field has seen significant advances over the past few decades due to factors such

as increased computational power, the availability of large datasets, and advances in machine learning techniques. Today, neural networks underlie many cutting-edge technologies and applications, including image recognition, speech recognition, and natural language processing.

Artificial neural networks (ANNs) are computational models inspired by the biological neural networks of the human brain. They consist of interconnected layers of nodes, or «neurons», that can process and pass on information. Each neuron takes in one or more input signals, processes them based on its internal state and activation function, and produces an output signal [5]. A basic neural network comprises an input layer, one or more hidden layers, and an output layer. The input layer receives the initial data, the hidden layers perform computations on this data, and the output layer provides the final result. Connections between neurons are associated with weights, which are adjusted during the learning process to optimize the network's performance. The process of training a neural network involves feeding it input data, comparing its output with the desired output, and adjusting the weights based on the difference, or «error». This process is typically repeated many times, allowing the network to «learn» from the data.

The application of neural networks in machine translation (MT) represents a significant evolution in the field. While earlier MT systems relied on rule-based or statistical methods, today's state-of-the-art MT systems are largely based on neural networks, specifically a type known as transformer networks, which use a self-attention mechanism to encode dependencies between elements in a sentence.One such system, CUBBITT (Charles University Block-Backtranslation-Improved Transformer Translation), has demonstrated the ability to outperform professional human translators on isolated sentences in certain contexts. In a blind evaluation by human judges, CUBBITT preserved text meaning significantly better than professional-agency English-to-Czech news translation [5].

However, while neural MT (NMT) systems have made significant strides in translation quality, challenges remain. For example, NMT systems can struggle with languages that lack large corpora of written text or standardized writing systems. They also often miss nuances critical to human speakers and can inject gender bias into their outputs [5].

Neural networks have been employed in various applications pertaining to language translation with considerable success. A prominent exemplar of this utilization can be found in Google Translate, which, in 2016, transitioned from a phrase-based translation system to a more advanced approach known as the Google Neural Machine Translation (GNMT) system. GNMT leverages the capabilities of a recurrent neural network subtype, the Long Short-Term Memory (LSTM) network. The deployment of this deep learning model has engendered substantial improvements in translation quality, notably for less frequently encountered language pairs. For example, previous translation models necessitated an intermediary translation to English when translating between Korean and Turkish, a process potentially fraught with errors. However, GNMT can conduct direct translations between such language pairs, often yielding more precise results.

Microsoft also harnesses neural networks in language translation, utilizing the Document Translator that employs a Transformer-based neural network model. Specifically designed to handle sequential data, the Transformer model has exhibited remarkable proficiency in language translation, outperforming preceding models by reducing errors significantly.

DeepL, a Germany-based firm offering translation services, uses artificial neural networks to deliver translations, often earning praise for its performance compared to other machine translation services. This commendable performance is predominantly attributed to DeepL’s proprietary neural networks and extensive language databases used for training. DeepL’ sofferings encompass a

multitude of languages, with its translations often perceived as more nuanced and contextually accurate than competing services.

Furthermore, SDL, an enterprise-focused firm, provides Neural Machine Translation (NMT) services. SDL's NMT system incorporates deep learning technologies and is trained on comprehensive bilingual data sets to yield highly accurate translations. The system offers further refinement through custom training, which allows for improved handling of domain-specific terminology and style, rendering it exceptionally beneficial for businesses in specialized fields.

Lastly, Amazon's contribution to this field is visible in the form of Amazon Translate, a neural machine translation service. Amazon Translate harnesses neural networks that are trained on a diversity of data sources to accommodate a broad spectrum of languages. Designed with scalability and cost-effectiveness in mind, Amazon Translate constitutes a viable option for businesses necessitating large-scale text translations.

These exemplary implementations of neural networks have significantly enhanced the quality and efficiency of machine translation across a vast array of languages. Despite the undeniable progress, it's important to note that machine translation continues to have limitations, and the intervention of human translators is often indispensable for ensuring optimal accuracy, especially in the context of complex texts.

For example, if we compare a translation of the part of scientific paper from English into Russian in the field of psychology, we may see these limitations.

One of the most significant methodological debates to have taken place in the psychoanalytic field in recent years concerns the nature of «clinical facts», which was the subject, in 1994, of a special seventy-fifth-anniversary double issue of the Internation al Journal of Psychoanalysis, edited by David Tuckett.

This debate was a response to a number of overlapping anxieties about the scientific status of psychoanalysis.

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One concern was why there were such apparently irresolvable differences between schools and perspectives in the psychoanalytic movement. There were issues of translation to consider too – how had the sense and meanings of Freud's writings in their original German been seriously modified through, for example, their translation into the English Standard Edition (Steiner, 1994)?

ChatGPT translation

Один из наиболее значимых методологических дебатов, которые проходили в области психоанализа в последние годы, связан с понятием «клинических фактов». В 1994 году этой теме был посвящён специальный двойной выпуск, приуроченный к семидесятипятилетию журнала «International Journal of Psychoanalysis» и подготовленный под редакцией Дэвида Такетта. Этот дебат возник в ответ на несколько волнующих вопросов относительно научного статуса психоанализа.

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Одна из проблем заключалась в том, почему между различными школами и направлениями в психоаналитическом движении наблюдаются такие, казалось бы, неразрешимые разногласия. Также стоял вопрос о переводе – каким образом смысл и значения письменных работ Фрейда на оригинальном немецком языке могли измениться при их переводе, например, на английский язык в Стандартное издание (Штайнер, 1994)?

DeepLtranslation

Одна из самых значительных методологических дискуссий, развернувшихся в области психоанализа в последние годы, вращается вокруг понятия «клинические факты». В 1994 году эта тема была в центре внимания специального двойного номера «Международного журнала психоанализа», посвящённого семидесятипятилетнему юбилею,

который редактировал Дэвид Такетт. Эти дебаты возникли в ответ на ряд опасений относительно научной обоснованности психоанализа.

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Одной из проблем было очевидное отсутствие разрешения разногласий между различными школами и взглядами в рамках психоаналитического поля. Кроме того, был затронут вопрос перевода, например, как оригинальный смысл и значение немецких трудов Фрейда могли быть изменены в результате их перевода на английский язык в Стандартном издании (Steiner, 1994).

The Russian translation provided above is quite accurate and captures the essence of the original text in English. It maintains the ideas and concepts, reflecting an understanding of the subject matter. However, there are some nuances and differences that can be pointed out:

David Tuckett's role

The English text states that the International Journal of Psychoanalysis issue was *edited by David Tuckett*, whereas the Russian translation refers to it as *подготовленный под редакцией Дэвида Такетта* which directly translates to *prepared under the editorship of David Tuckett*. Though both statements hold similar meanings, the latter implies that David Tuckett had more of an overseeing role rather than being the direct editor.

Translation Issue

The English version uses the phrase *seriously modified through, for example, their translation*, while the Russian translation uses *изменитьсяприихпереводе*, which directly translates to *change during their translation*. Here, the Russian text doesn't capture the severity (*seriously modified*) of the modifications that occurred during the translation of Freud's works.

Spelling of *Steiner*

In the Russian text, the name *Steiner* has been translated as *Штайнер*, which is a common way of transcribing this name into Russian. However, in an academic or formal context, it might have been more appropriate to keep the original spelling of the name to avoid any potential confusion, as we see in DeepL translation. At the same time DeepL provides translation of the journal, but the name of the journal is not translated into Russian.

The Nature of *Clinical Facts*

In the English version, *clinical facts*is in quotes, implying that it's a specific term or phrase with a particular meaning in this context. In the Russian translation, *клинических фактов* isn't in quotes, which could potentially alter the original intent.

And introductory phrasing, which is *One of the most significant methodological debates...* has been translated to *Один из наиболее значимых методологических дебатов...*, which directly translates back to *One of the most significant methodological debates....* In this case, the use of *наиболее* might be considered a bit formal or even old-fashioned in modern Russian language, but this is quite a minor stylistic issue and doesn't impact the overall meaning. More important to pay attention to the word *debate* and translate it *дискуссий*.

Given their ability to learn from data and handle complex, non-linear relationships, neural networks hold considerable potential for addressing language translation challenges in metaverses.

Firstly, their capacity for handling a broad range of languages could help to bridge language barriers and promote inclusivity. Companies such as Amazonand DeepLare currently investigating the application of machine learning techniques, including neural networks, to create translation software that can cater to the full range of languages spoken by users of their platforms [5].

Secondly, neural networks' ability to handle multiple modes of data simultaneously could be valuable for translating multimodal communication in the metaverse, including written text, spoken language, and potentially even non-verbal cues.

Finally, the ability of neural networks to learn from data could enable them to adapt to new linguistic phenomena that may emerge in the metaverse, such as digital dialects or metaverse-specific lingo.

Translation in Metaverses

Translation in Metaverse refers to the use of virtual reality technology to facilitate multilingual communication and understanding in immersive environments. This can be achieved through various means:

1. Real-time speech-to-text translation.

Virtual reality headsets can be equipped with speech recognition technology to transcribe spoken language into text in real-time. This text can then be displayed in the user's field of view in their preferred language.

Real-time speech-to-text translation in the metaverse could be a game-changing technology, as it would allow users who speak different languages to communicate with each other seamlessly. Here are some possible ways this technology could be implemented:

2. Voice recognition software.

The first step would be to use voice recognition software to convert spoken words into text. This technology is already widely available, and it could be integrated into the metaverse to allow users to speak with each other in their native language.

3. Natural language processing.

Once the spoken words have been converted into text, natural language processing (NLP) algorithms could be used to analyze the text and translate it into the user's preferred language. This would require training the NLP models on a vast amount of data to ensure accurate translations.

4. Integration with existing translation services.

Another option would be to integrate the real-time speech-to-text translation technology with existing translation services, such as Google Translate or Microsoft Translator. This would allow the metaverse to leverage the existing translation technologies and provide users with high-quality translations.

5. Multilingual avatars: In addition to translating spoken words, the metaverse could also use multilingual avatars that can communicate in multiple languages. This would allow users to select an avatar that speaks their native language and communicate with other users in the same language, without the need for translation. Virtual reality environments can also utilize text-to-speech technology to convert written text into spoken language, allowing users to communicate with others who speak a different language. Some VR applications use avatars or digital representations of users to facilitate communication in a virtual environment. These avatars can be programmed to speak different languages, allowing users to communicate across language barriers.

Discussions and potential future developments

One major challenge is the need to translate a large amount of content, including dialogue, user interface elements, and other text. This is particularly challenging for virtual worlds that have a large amount of user-generated content. For example, in Second Life, users are able to create their own virtual spaces and objects, which can be in any language. This means that the platform needs to be able to handle a wide variety of languages and content types.

In addition to these linguistic challenges, there are also technical challenges to consider. Different virtual world platforms may have different ways of handling text and other content, which means that translators and developers need to be familiar with the platform they are working on and its specific technical requirements. They also need to be able to work with the

platform’s APIs and other technical tools to ensure that the translations are integrated correctly.

There is also a need for real-time translation during online interactions, especially in multiplayer games. In virtual worlds like World of Warcraft, players from all over the world play together and communicate with each other in real-time. This makes it necessary to have real-time translation tools that can help players understand each other regardless of their language. While there are automated translation tools available, they may not always be accurate and can still result in miscommunication.

Poorly translated content can be confusing and frustrating for users. In virtual worlds and metaverses, the user experience is critical for keeping users engaged and interested. It can be a barrier to user engagement and can lead to higher churn rates.

To address these challenges, some virtual world and metaverse platforms have built-in translation features that can automatically translate text in real-time, making it easier for users to communicate with each other. However, these features may not always be accurate and can still result in miscommunication.

Another approach is to rely on human translators to translate content, which can ensure accurate translations, but can also be time-consuming and expensive. Additionally, it may be difficult to find translators who are proficient in the specific language and cultural nuances required for a particular virtual world or metaverse.

As virtual worlds and metaverse continue to evolve, effective solutions are needed to address language barriers and translation challenges. This may include a combination of automated and human translation, as well as continued development of translation technology to improve accuracy and efficiency.

Stepes is a company that provides AI-powered translation management systems and professional human linguists to translate content into various languages. Stepes’ software localization capabilities are comprehensive, it offers

professional metaverse translation services in over 100 languages, including software GUI strings, product documents, training videos, and marketing websites. Stepes specializes in virtual reality (VR) and augmented reality (AR) translation services [6].

Amazon Translate is a neural machine translation service that delivers fast, high-quality, affordable, and customizable language translation [6]. It supports 75 languages and has seven integrations with translation management systems [7]. Amazon Translate can be used to translate text between languages in the cloud [8], and it is available as an API for developers to integrate into their applications [9]. The service is designed to provide fast, high-quality translations at an affordable price point. Amazon also has a Translation Team that hires professionals for roles in translation, proofreading, post-editing, and outsourcing [10].

Furthermore, cultural differences can arise in virtual worlds and metaverses, impacting how users interact with each other, perceive the virtual world, and interpret the content within it. To ensure that content is culturally appropriate for all users, it may be necessary to have a diverse team of translators and content creators who can provide different perspectives and insights. It may also be beneficial to provide users with tools to customize their experience to better suit their cultural preferences.

Заключение

In conclusion, as virtual worlds and metaverses continue to become more global, addressing language barriers and translation challenges will become increasingly important. Effective solutions are needed that balance accuracy, efficiency, and cultural sensitivity to ensure that all users can fully participate in and enjoy these virtual environments. Keeping these challenges in mind and continuing to innovate will create more inclusive and accessible virtual environments.

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