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ҒЫЛЫМИ-ПРАКТИКАЛЫҚ
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СУЛТАНГАЗИНСКИЕ ЧТЕНИЯ

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«Сұлтанғазин оқулары-2023» халықаралық ғылыми-тәжірибелік конференциясының «Заманауи білім беруді дамытудың өзекті мәселелері» жинағында жаратылыстану-ғылыми білім берудің мәселелері мен болашағына арналған ғылыми мақалалар жинақталған, жалпы және кәсіптік білім берудің психологиялық-педагогикалық аспектілері қарастырылған, педагогикалық білім берудің ақпараттандыру және дамытудың қазіргі тенденциялары мен технологиялары мәселелері қозғалады.

Осы жинақтың материалдары ғалымдар мен жоғары оқу орындарының оқытушыларына, магистранттар мен студенттерге пайдалы болуы мүмкін.

В сборнике Международной научно-практической конференции «Султангазинские чтения-2023» «Актуальные вопросы развития современного образования»: представлены научные статьи по проблемам и перспективам естественно-научного образования, рассматриваются психолого-педагогические аспекты общего и профессионального образования, затронуты вопросы информатизации и современных тенденций и технологий развития педагогического образования.

Материалы данного сборника могут быть интересны ученым, преподавателям высших учебных заведений, магистрантам и студентам.

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оқытушылар ең жаңа виртуалды технологиялар туралы жақсы біледі, өз жұмысында онлайн-жүйелерді пайдаланады және жоғары оқу орындарының білім беру процесіне өзекті ақпараттық-коммуникациялық технологияларды одан әрі енгізуге дайын.

AR және VR-шындық технологиялары күн сайын белсенді түрде жаңғыртыла отырып, жоғары кәсіптік білім беру саласында үлкен даму әлеуеті мен одан әрі перспективалары бар деп айтуға болады.

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COMPARATIVE ANALYSIS OF TRANSLATION ALGORITHMS FROM TEXT TO SIGN LANGUAGE

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Аңдатпа

Бұл мақаланың өзектілігі Қазақстанда жестау тілі жақында зерттеле бастады және осы салада инновациялар енгізуді талап етеді. Мақсатs - орыс, чех және Жаңа Зеландия сияқты жестау тілдерінің әдістері мен алгоритмдеріне салыстырмалы талдау жүргізу. Бұл мақалада кейбір елдердің ым тілі бойынша бірнеше зерттеу жұмыстары қарастырылды. Зерттеу барысында семантикалық талдаудың қазақ ым тілімен айырмашылығы мен ұқсастығы байқалды. Авторлардың жұмысының нәтижелері боп табылатын веб-сайттар және сурдоаудармаға арналған дербес жүйелер қарастырылды:

Түйінді сөздер: ым тілі, сөздік, электронды сөздік, семантика, сурдоаударма.

Аннотация

Актуальностью данной статьи является, что жестовый язык в Казахстане начало исследоваться недавно и в этой отрасли требуют внесение новшеств. Целью является проведение сравнительного анализа методов и алгоритмов таких жестовых языков как, русский, чешский и новозеландский. В данной статье было рассмотрено несколько исследовательских работ по жестовому языку некоторых стран. В ходе исследования, были замечены отличие и сходство семантического разбора с казахским жестовым языком. Рассмотрены результаты работ авторов: веб-сайты и автономные системы для сурдоперевода.

Ключевые слова: язык жестов, словарь, электронный словарь, семантика, сурдоперевод.

Abstract

The relevance of this article is that the sign language in Kazakhstan has been studied recently and innovations are required in this industry. The goal is to conduct a comparative analysis of methods and algorithms of such sign languages as Russian, Czech and New Zealand. This article reviewed several research papers on the sign language of some countries. In the course of the study, the difference and similarity of semantic analysis with the Kazakh sign language were noticed. The results of the authors' work are considered: websites and autonomous systems for sign language translation.

Keywords: sign language, dictionary, electronic dictionary, semantics, sign language translation.

According to the World Health Organization, about 5% of people in the world (328 million adults and 32 million children, a total of 360 million people) suffer from hearing loss. Disabling hearing loss refers to hearing loss in the better-hearing ear exceeding 40 dB in adults and 30 dB in children.

According to statistics, every third person over the age of 65 suffers from disabling hearing loss. Most of these people live in regions with low social security, and in this age category the highest prevalence is observed in South Asia, the Pacific region of Asia and sub-Saharan Africa.

Since "deaf" people hear very little or do not hear at all, they often use sign language to communicate [1].

According to WHO estimates, by the middle of the 21st century, about 1 billion people, or one in ten, will have problems associated with hearing loss.

At the moment, more than 13 million people with hearing impairment live in Russia, including more than 1 million children. The figures are also disappointing in the Czech Republic: there are about 0.5 million people with hearing impairments (5%) in the country, most of them are elderly people. 15,000 people have congenital or acquired hearing loss (0.15%) in childhood, no more than 8,000 children of which have significant or complete deafness. Today, 680,000 people with disabilities live in Kazakhstan, according to the Ministry of Labor and Social Protection of the Population of the Republic of Kazakhstan. This is 3.7% of the total population of the country. At the same time, out of a total of 417.9 thousand people are of working age, but only 111.5 thousand people are employed.

According to the All-Russian Society of the Hearing Impaired, the number of deaf people who are native speakers of sign language is more than 300 thousand people. These statistics included those who lost their hearing completely or partially at an early age or with congenital hearing defects. Also in the Czech Republic, there are about 7300 sign language users [2].

Considering the above statistics, sign language is still a topical subject of research. To solve the existing problems associated with the Kazakh sign language, scientific articles of some Russian and foreign authors were considered.

The article by Czech authors presents a sign language dictionary developed by a research group of the University of West Bohemia, Masaryk University and Palacky University [3]. This work shows the process of creating both an explanatory and a translation dictionary. The dictionary is primarily focused on Czech and Czech Sign Language. First, the technological aspects of the dictionary are described, and then the data collection methods. The dictionary is an application created with linguistic needs in mind. Written text is used to represent spoken languages, and multiple views are supported for sign languages: video, images, HamNoSys, writing characters, and an interactive 3D avatar. To reduce the time required to collect and publish data in the dictionary, computer vision techniques are used for video analysis to determine character boundaries and analyze the manual component of the executed character for automatic classification. To create content, the authors involved linguists to use both new and existing data. The dictionary should then be open to the public with the ability to add, modify, and comment on the data. In addition, the mobile interface of the dictionary is also described. The mobile interface uses different web page formats and different video compression methods optimized for slower Internet connections. It also states that there is an offline version of the dictionary that can be automatically generated from online content and downloaded for offline use.

The article is still relevant today, as sign languages can use dictionaries for several purposes. Translation dictionaries are used to translate words (or phrases) from one language to another, explanatory dictionaries define words in the same language rather than translating them. Traditional dictionaries for spoken languages use written text as the primary form for creating content. This becomes more difficult for sign language, where the written form of the language is not as developed and common among the community. Thus, this article solves a number of problems regarding sign language using machine learning methods (computer vision) and 3d models [4].

A feature of the authors' approach is a search engine that provides relevant results to the user's query. For spoken languages, the user provides the search term, language, and possibly subject and grammatical information (eg, part of speech). The result of the authors' work is a list of words that meet the specified search criteria. For the Czech language, a lemmatization mechanism is used, which allows searching among various inflectional forms of the same words [5].

In addition, the search is not limited to just the head of the words, but provides a full-text search across all text elements (values, explanations, use cases, etc.).

In these works, more attention is paid to visualization tools (3D model, avatar) and translation is based on transcription elements, however, the topic of semantic analysis is considered superficially. Czech Sign Language (CSL), like other languages used in everyday communication, has its own vocabulary and grammar. The number of gestures in many SLs is much less than the number of words in the language itself. At the same time, different denotations can be indicated by the same gesture. In sign language, the rules of morphological and syntactic changes are present in a very vague and unformed state, which certainly requires additional research and development of new algorithms in this area.

In the scientific works of Yu.S. Manueva, M.G. Grif and A.N. Kozlov, a review of the existing systems of computer sign language translation was carried out, their advantages and disadvantages were identified. The general state of the translation is taken into account (in both directions): from the sound of the Russian language into Russian sign language and vice versa. A new method for constructing a semantic block of a system of computer translation into sign language is proposed [6]. To determine the "word-sign" correspondence, the lexical meanings of words are identified. Among the many alternatives based on the semantic analysis algorithm, each word is given a single lexical meaning. Semantic analysis algorithms have been developed that are applied to simple sentences. The method of translating Russian text into Russian sign language is based on the comparison of syntactic structures. An appropriate library has been developed to identify syntactic constructs. Existing hardware, software and software were considered to create the architecture of the character recognition system.

The semantic analysis algorithm consists of the following steps.

1. Selection of a list of alternative lexical meanings.
2. Processing phraseological units.
3. Processing prepositions.
4. Fixing lexical meanings.
5. Search for relevant gestures.

The main task of semantic analysis is the enumeration of independent alternatives and the calculation of the semantic-grammatical types of each alternative included in the description. These changes are made in several stages. The first step is to find all alternative meanings of each word in the sentence. At the second stage, auxiliary work is performed: all variants of each word are numbered and determined, the number of semantic classes of the word is taken, all arguments are selected from the description of the value. The constructed description consists of a set of alternatives, each of which consists of two main parts: morphology, which represents the semantic class of the word "Means of communication with a computer", and semantics. The first part of the alternative is information about which words can be attached to this word, the second part - which words can be combined. When installed, two adjacent structures are involved in the interaction.

In addition, these works use:

1. Tuzov's semantic dictionary, reflecting the translation into the semantic language of the words of the Russian language and the creation of a working computer system for the semantic analysis of texts in Russian, which has an inflectional structure opposite to the agglutinative one, respectively, the semantic analysis algorithm according to V. Tuzov's dictionary cannot be fully transferred to the Kazakh language [7].
2. Dictionary of homonyms of the Russian language Akhmanov O.S. For the Kazakh language, you can use the dictionaries of homonyms of the Kazakh language "Kazakh tilinin homonym sozdigi" by the author M. Belbayeva, and "Kazakh tilindegi homonym" by the author K. Akhanov [9].

The most priority areas for modifying the semantic analysis module include the following: expanding the base of gestures, parsing complex sentences, adding classification predicates of the sign language into the analysis algorithm.

For the Kazakh sign language, it is necessary to research and develop algorithms that take into account the morphological, syntactic and lexical features of the Kazakh language, such as:

1. stress, intonation and vowel harmony
2. variable parts of the word (zhalgaular: zhiktik, taueldilik, koptik, septik)
3. ways of constructing phrases (matasu, kiysu, kabysu, zhanasu)
4. features of the indefinite form of the verb
5. word order in sentences

Considering all these and other works, in the future will be developed a dictionary of the Kazakh sign language, which will help translate the text into sign language.

The Online Dictionary of New Zealand Sign Language (ODNZSL)1, released in 2011, was further reviewed as an example of a modern sign language dictionary that takes advantage of the digital media of the 21st century and the existing body of descriptive language research, including the small electronic

corpus of New Zealand Sign Language. Innovations in the latest online dictionaries of other sign languages provided the basis for the development of this bilingual, bi-directional, multimedia dictionary. Video content and online search capabilities are a huge advancement in a more direct representation of signed vocabulary and allow users to access content in a variety of ways, but do not solve all the theoretical problems faced by developers of sign language dictionaries [8]. This article discusses considerations for editing and producing ODNZSL, including defining lexemes and word class in a semi-synthetic language, deriving usage examples from a small corpus, and considering sociolinguistic differences in content selection and execution.

ODNZSL illustrates the potential of the online environment to provide a more dynamic and authentic representation of sign language vocabulary and provide users with an interactive help tool. A key element that enriches both descriptive and instructive value is the addition of video content in addition to line drawings of characters that can be downloaded for offline use. The relational nature of online search circumvents macrostructural issues related to record order and facilitates bi-directional searches through visual cues of characters or word equivalents, topic domains, or other tags. The "search by sign" feature (using hand shape and location features) promotes receptive use by learners who want to identify unknown vocabulary; this feature and the NZSL translation of frontal material also increase the vocabulary's accessibility for deaf NZSL users. Searching by hand shape/location returns a list of shape results that more or less exactly match the search parameters; they are displayed using illustrations of signs and hyperlinked links, which can be viewed directly from the results page or refined by returning to the sign function menu.

There is a lot of ambiguity and some homophony in the NZSL lexicon, which requires decisions to be made about how to represent plural relations of form and meaning. In addition to semantic context, an important means of disambiguating the meanings of ambiguous and homophonic signs in NZSL is the simultaneous pronunciation of spoken English words, which is due to the fact that deaf people encounter this vocabulary in their daily lives. Joint articulation of spoken words with hand signs occurs in many sign languages, and the status of spoken words in relation to sign lexicon is a matter of theoretical debate that is beyond the scope of this article (e.g. Boyce-Brem and Sutton Spence 2001, Ebbinghaus and H. Hessman 1996). Suffice it to say that spoken language plays an important role in lexicographic decisions about multi-valued signs, but is not often discussed explicitly in connection with the practical aspects of compiling sign language dictionaries.

The editorial benefits of an online environment include the ability to easily edit records with overnight database updates and support a multi-user team collaboration workflow. New records can be created as new data comes in, and the microstructure of the records can potentially be adapted to map fields that are different from the records in the database. The electronic medium does not solve long-standing lexicographical problems for sign language researchers, such as: determining what corresponds to entry status (i.e., handling characters that are not lexicographically slightly); definition of morphologically unmarked citation forms; assigning a word class; achieving lexical-pragmatic equivalence between words of different languages (in this case NZSL, English and Maori); account of statements; and the representation of variation (in the choice of content and in its embodied performance). However, the environment facilitates consultative and recursive editing processes and allows content decisions to be revisited in the light of new data and ideas.

Sign languages are characterized by their visual-spatial modality of production; the transitions in the movement and shape of the hands are vital for distinguishing the form and meaning of signs. Accurate analysis and presentation of these articulation features in a dictionary is important both for the searchability of the content and its value as a learning tool. The power of video content has been well exploited in recent online dictionaries for Flemish Sign Language (Van Her-reweghe et al. 2004), Swedish Sign Language (Institutionen för Lingvistik 2009), Danish Sign Language (Tegnsprog Center 2008) and Finnish Sign Language (Kuurojen Liittory 2003).). Although the line drawings in the NZSL print dictionaries (1997 and 2002) were highly accurate, the ability to represent characters and their context in isolation through video clips is transformative.

The definition of the grammatical category (part of speech) in signed lexicons is a serious problem for lexicographers and linguists, and the authors considered options for parsing words and phrases from a morphological and syntactic point of view. Surveys were conducted on the question “Should commonly inflected forms of verbs appear as entries?” and on this occasion, it was difficult to create certain signs (usually verbs and adjectives) devoid of inflectional morphology (e.g. manner, degree, location), assuming that, although these functions were theoretically optional, in natural usage they were closely related to vocabulary.

According to this article, it is clear that the authors did a very good job on visualization, video replication and creation of a database, but the semantic and syntactic analysis of words is not carefully considered. About synonymy and homonymy, examples of individual words were given, but a number of questions arise:

1. The linguistic analyser performs morphological, syntactic and semantic analysis of the text and gives as a result of its work a semantic representation of the situation in the form of an ontology fragment.

2. Based on this semantic representation, with the necessary extensions from the ontology, the gesture synthesizer synthesizes whether (taking into account the grammar of the sign language) a sequence of gestures.

3. Is linguistic analysis based on the method of contextual fragmentation and does it allow the analysis of both simple complete natural language sentences and complicated, complex, elliptical and anaphoric sentences.

To sum up all information, authors considered only words and a couple of phrases without a sentence. From the context of the work, it can be understood that not so much attention is paid to the lexical meanings of words.

In all three works, the dictionaries combine three main principles:

- Full autonomy of data for each language (signs are not considered equivalent to some words, and first of all the sign must be explained using sign language).
- Philological accuracy and completeness.
- Semantic sets (groups of synonyms)

Thus, each language is an independent lexical-logical network connected by synsets and phrases, and these independent networks (lexicon) are freely connected with each other only through identical semantic features of their lexical units. Each lexical element (record, lemma) is described using two groups of fields:

Formal description

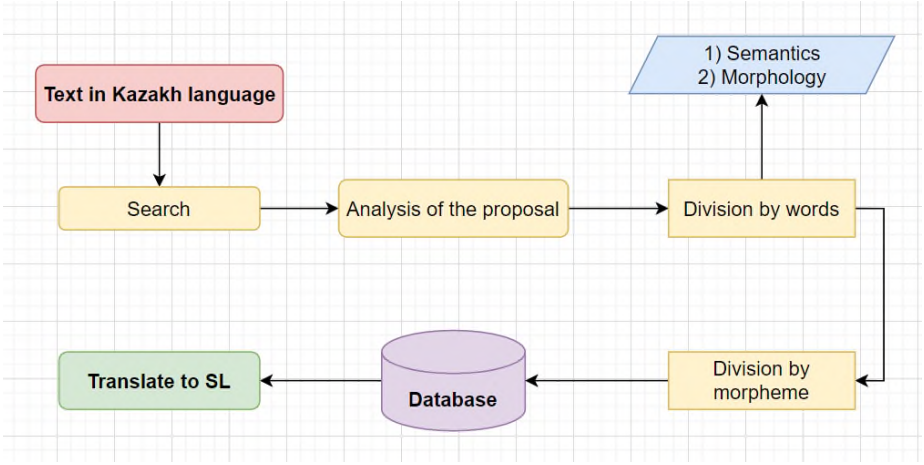
Representing the form of the lemma:

- alphabetical text (standard spelling as the basic representation of words in spoken language, alphabetical transcription of the character if such a system exists)
- audio/video presentation (one or more audio or video formats to represent pronunciation and/or pronunciation in spoken language; signature in sign language)
- analytical description of acoustic or visual reality (transcription of IPA in spoken language, SW or HamNoSys in sign language, etc.)
- verbal description of acoustic or visual reality (text comments on pronunciation or pronunciation, verbal description of signs)

Lemma form classification:

- grammatical categories of the part of speech
- stylistic categories

Russian and Czech authors pay more attention to semantics and stylistics; linguists were involved in the development of syntactic and morphological analysers. The work of these analysers is carefully considered and described in their writings. By examining the works of these authors, an architecture was created for translating from the text of the Kazakh language into sign language (Picture 1).



Picture 1 – Architecture of translation from text to KSL

And by visualizing video demonstrators and 3d models, New Zealand and Czech researchers show that they used computer vision and additional systems. In addition, Czech authors have a unique search engine that uses transcription, dactyls.

Over the past few years, sign language in Kazakhstan has advanced very well, for 8 years now there has been a platform surdo.kz for people who suffer from hearing loss [10]. Several hundred videos have been shot for Kazakh words using the Kazakh alphabet. There are also folk proverbs, sayings and fairy tales in sign language. With the help of this platform and tools, not only hard of hearing people are trained, but

also their parents and guardians. At the moment, this industry is increasingly being explored and developed thanks to technology. In the future, works that include artificial intelligence, such as computer vision and recognition, will be presented.

Conclusion. This research work considers the articles of some authors: Russian, Czech and New Zealand. A comparative analysis was carried out, as a result of which the main models and types of text translation into sign language were identified, and priority areas for further modification were selected. Due to the difference in semantic properties between these languages and the Kazakh language, the study noted moments and algorithms that should be adapted to the Kazakh sign language. Each work has video images, HamNoSys, sign writing, and an interactive 3D avatar that helps visualize sign language. However, not all works contain analysers of synonyms, homonymy and semantic, syntactic links. More attention was paid to the collection of the database and the search engine. Almost all authors show websites and an autonomous system as a result of their work that help to learn sign language and partially translate, but not everyone has a full-fledged text translator into sign language.

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ИСПОЛЬЗОВАНИЕ ЦИФРОВЫХ ОБРАЗОВАТЕЛЬНЫХ РЕСУРСОВ В ПРАКТИКЕ ПЕДАГОГА

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Аңдатпа

Қазіргі уақытта заманауи мұғалім тәжірибесінде цифрлық білім беру ресурстарын дамыту өзекті болып табылады. СББР электрондық оқытудың негізі болып табылады. Осыған байланысты оларды дамыту мен пайдалану механизмін зерттеу оқу үдерісін жаңғыртудың және оны техникалық қамтамасыз етудің маңызды міндетіне айналады.

Түйінді сөздер: СББР, мультимедиа, сабақты дидактикалық қамтамасыз ету.