DEVELOPMENT OF TRANSLATION TOOLS FROM THE NATURAL LANGUAGE ON SIGN LANGUAGE OF DEAF PEOPLE

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Abstract

It's being proved the necessity of development of the program for translation of the natural text on sign language used by deaf people, the description of foreign analogues is resulted. The problem of development of the specialized interface for use by deaf people in means of communication is considered. The description of novelty of the used approach is given. It is being stated the assumption, that the used approach will not only allow to create the program of text translation in gestures, but also will be useful in solution of problems of processing the natural verbal languages.

1. An urgency of a considered problem

Item 7 Rule 5 of the Appendices to the Resolution of the Organization of the United Nations 48/96 «Standard rules of maintenance of equal opportunities for disabled people» says: «It is necessary to take care of that the sign language was applied to training deaf children, in their families and communities. It is also necessary to provide services on sign language translation to give deaf people the opportunity to communicate with other people».

The United Nations call «to apply those Rules in states-members by development of national programs for disabled people» (item 2 of the Resolution), and also «urgently calls to states-members to provide financial and other support for the realization of Rules» (item 5 of the Resolution) [1].

For now the sign language in Russia is recognized as language of interpersonal communication (the Federal Law № 181-FL from 11/24/1995 «About social protection of disabled people in the Russian Federation»). But there are groups of deaf people and supporting them, which are struggle for assignment of the state status to the sign language. Deputies of the State Duma A.Chuev and S.Glazyev in 2003 have brought in the corresponding bill which has not been admitted to voting and in 2004 have been returned to authors due to the lack of calculation of expenses and the instruction of a source of their compensation in case of acceptance of the law. At the same time in the Moscow Municipal Duma the bill of City, obliging doctors, fire, militiamen to know sign language, was considered. Till the present it is not accepted. It is possible to expect, that to forthcoming elections to the State Duma these attempts will renew. In case of acceptance of the law giving to sign language the state status, the need for training manuals on sign language will sharply increase, including the means of the automated sign language translation which on complexity and functions do not concede to the means of processing of natural languages, and on several parameters surpass them.

2. A current condition of researches in the given area

The projects intended for translation of text to gestures and for demonstration of gestures in a window of the program or an Internet browser are known. As an example it is possible to refer the Mimehand II project (fig. 1), being developed by Hitachi Europe company, Ltd (Great Britain) within the framework of "the electronic government" project [2].

As the most advanced for today the project of company Vcom3D (Orlando, Florida, USA) [3] can be considered. This project is being carried out since 90th years, now it includes the extensive dictionary of American Sign Language (ASL) gestures, the beta-

version of the editor of gestures (Sign Builder), with which help the user to record new gestures (fig. 2). This software provides the user 12 various shapes (skins) of virtual characters. The Sign Builder was developed in 2004.

Sign Builder allows to edit position of hands in space to set the key points of gesture animation and to record the information of key points (a base configuration, coordinates in space) on a time scale. Adjustment of positions of hands is carried out by moving the sliders using mouse. This information and the data on time of execution of separate movements are recorded in a script-file which can be played in Sign Smith Studio software (fig. 3).

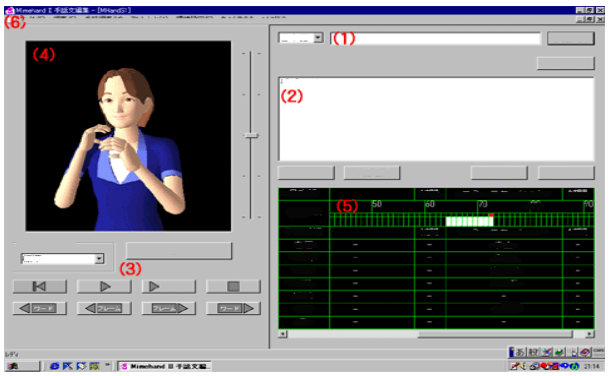

Fig. 1. A workspace of Mimehand II program

Fig. 2. Sign Builder [1]

[1] Published with an agreement with Danny Roush "Sign Builder" project director.

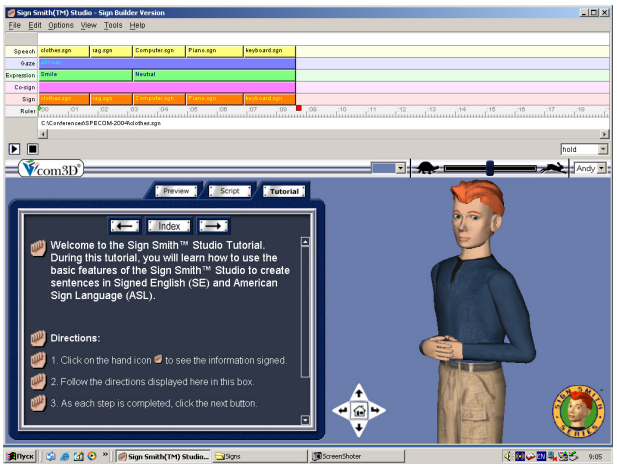

Fig. 3. A workspace of Sign Smith Studio software

In May, 2005 as a result of the European "eSign" project [4] in which research the universities and the companies of Germany, the Great Britain and Netherlands took part, has appeared Guido avatar (fig. 4), which can represent gestures of German, English and Dutch sign languages.

Fig. 4. Guido avatar

Text translation in gestures in the "eSign" project is carried out as follows: skilled signers code the initial text in special notation HAMNOSYS («the Hamburg system of the notation»), developed in Institute of German Sign Language at the Hamburg University. Then the code is used for management of Guido avatar, showing gestures.

According to available information on the specified project, the system carries out "translation" of the text in gestures by searching of words from the initial text in an index of the built-in dictionary, and then shows the images of gestures chosen from the dictionary following words of the initial text. Thus, we have code conversion of the initial text by gestures and as a result just series of “calque” sign speech statements, instead of translation on true sign language [5].

3. Essence and novelty of offered development

In represented project it is offered to carry out the analysis of the initial text semantics taking into account [6, 7] and to form the sign language statements corresponding to semantic values of the processed text. To make a selection from database of required gestures it is offered to use the methods similar to described in [8]. Besides that, the development of the innovative specialized interface for communication by people with restrictions on hearing and reproduction of speech is offered.

The specified approach and used methods are innovative and have no analogues.

3.1. The animated dictionary of gestures

The first stage of work on discussed project is a creation of the multimedia dictionary of Russian Sign Language in volume 5 - 6 thousand the gestures, including for each record a text field (fields) with examples of application of the concept displayed by the given gesture. Development of such dictionary will allow to fill up the lack of methodical materials which at lack of the specialized educational institutions for deaf people essentially complicates studying of Sign Language.

3.2. The interface for people with restrictions on hearing and reproduction of speech

The communication for people with restrictions on hearing or reproduction of speech is taking place in completely different way, than it is for people without such restrictions. People with such restrictions cannot watch TV, listen to radio without additional means, communicate by phone as it done usually by people. So it is necessary to develop the approach to realization of a series of the specialized interfaces which could be used in any telecommunication devices. As well as any other interface, the product being presented should include means of input of the information, means of its output and the data link [9].

As for data links they are already good enough and widely used, therefore two other components should be projected to use already existing data links.

The output of the information as it was already stated above can be carried out by means of an animated avatar. Avatars can reproduce gestures by two ways:

- Generating gestures for corresponding expressions in a natural language using script sequences from database;
- Reproducing the animation of gestures transmitted to it directly under the data link.

The subsystem of input of the information also can work by two following ways:

- Generating expressions in a natural language according to the analysis of gestures reproduced by the operator;
- Transforming gestures of the operator to script sequences of animation for an avatar.

We offer to design the system of input of the given interface on the basis of the simplified system of human motion capture [10].

3.3. The analysis of semantics for correct translation[1]

Usually text processing includes the following basic stages: the morphological analysis, syntax analysis and the semantic analysis. In several systems last stages are united [11].

Practically in all cases the specified processing is being done within the limits of each separately taken sentence. But, for example, in two following sentences: «Come. I live on 6-th floor.» And «My house is high. There are 6 floors in my house.» There are two various gestures corresponding to the word "floor".

The additional analysis shows, that the first variant of gesture is used in the description of the dynamic situations, and the second is for static. Therefore in a context «Come. There are 6 floors in my house.» the second variant of gesture is used.

It is clear, that to understand the text, it is not enough to analyze separate sentences. It is necessary to analyze, what and what about is told in these sentences, and to connect together sentences of the text in which it is told about the same subjects and objects. Such processing cannot be done without using of means of semantic search.

Conditions of restriction of semantic search sphere for increasing the accuracy of its results in identification of the objects mentioned in various sentences of the text, can be revealed from results of analyzing the parameters of referential choice in a discourse [12].

Various solutions of a problem of uncertainty removal for choosing the necessary value of the

[1] The research on a subsystem of the semantic analysis is carried out with financial support of «Human capital» foundation (http://hcfoundation.ru, the contract on reception of the grant № 67 from 12/30/2005).

homonym are known, those solutions use dictionaries of synonyms, comparison of local contexts and thesauruses.

One of the points of given work is a problem of tracking of different words and word-combinations which have the same or close meaning.

In [8] results on an experimental estimation of a technique of semantic search of the documents concerning to the current subject domain are submitted. This technique is an expansion of the theses formulated in [13] for local context. But as for a problem of text translation in gestures the specified technique is only one of elements of text processing.

It is possible to develop corresponding rules on the basis of the syntactic and semantic analysis of the texts explaining the features of the gestures using. So, for example, for a word "floor" from the example stated above the choice is carried out as follows:

Variant 1: "floor" + a verb representing an active action.

Variant 2: "floor" + a verb representing an existence.

In case of absence of a verb in the analyzed sentence, it is possible to include the neighbor sentences into analysis, being limited (according to results [12]) limits of one paragraph.

So, text translation in gestures will include the following procedures which are carried out using the results of morphological and syntactic analysis of words and word-combinations of the input text:

- The reference to the knowledge base of the sign language dictionary, extraction of corresponding rules;
- Revealing the modifier of value on the basis of these rules and checking on presence of the modifier in the initial text;
- Demonstration of the gesture satisfying the results of the semantic analysis.

Checking for presence of modifiers and definition of their values is carried out by reference of an analyzed text fragment to corresponding class of the taxonomy constructed on the basis of the analysis of texts, explaining the features of using the gestures. Thus for "fuzzy" classification the technique offered in [8] is used.

It is supposed, that the discussed technique can be used not only for a problem of text translation in gestures, but also for other problems demanding understanding of the text. As, for example, it is mentioned in [14], «frequently various dictionary sources give a various set of values of multiple-valued words, give shades of values, and the same type of a polysemy can be differently described for various words even in the same dictionary».

Use of the taxonomy based on values of gestures, will allow to avoid the subjectivity inevitably brought in taxonomy, created by separate authors or groups of authors.

4. Expected results

The purpose of the given project is the solution of both social and scientific problems.

The social component of the project sets as the purpose creation of preconditions for implementetion of Rule 5 item 7 of the Resolutions of the United Nations 48/96.

It is supposed using virtual characters (avatars) for creation and editing of gestures. Gesture is recorded as a script managing the avatar. Set of similar records together with auxiliary texts forms the dictionary of a Sign Language. For the purpose of translation text in Sign Language the Sign Language grammar is added to the dictionary. This program (together with means of recognition of speech) can be used during assemblies or for subtitration by gestures of telecasts and films, etc.

The program of translation of gestures in the text (together with means of generation of speech) can be used (together with the program of text translation in gestures) for the automated sign language translation. If there were descriptions various Sign Language in a bank, it would be possible to create the means of machine translation between different Sign Languages.

The creation of the discussed interface on the basis of the specialized human motion capture system will allow making accessible to people with restrictions on hearing and reproduction of speech any telecommunication means.

The scientific component of the project - the studying of Sign Language will allow understanding better the features of thinking of deaf people and will enable us to create corresponding training courses.

Creation of the means similar to used in queries to databases in a natural language, text-through search, search in the Internet or automatic classification [16] is planned for queries to bank of gestures.

The language not only object of studying in the linguistics studying verbal languages, but also it is the tool of the researcher. However it is impossible to describe any system from within, it is necessary to leave the limits of described system. It is evidently, that investigation of gestures, illustrating ways of thinking of deaf people will help in the solution of a problem of sense transfer in a natural language. Therefore progress in creation of machine translation systems for the verbal languages using the knowledge bases and ontology will be achieved. The search of effective translation tools of the text in gestures has allowed formulating solutions [8] which may be useful during

intellectualization of an existing Internet network and its transformation into Semantic Web.

Besides that, the offered approach to development of the specialized interfaces for communication of disabled people is also innovative.

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