Studies on Emotions Translation in the Thetos System

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Abstract

The paper deals with the problems of improving the functioning of the Thetos system, intended for translation of Polish texts into the Polish sign language. Experimental identification and translation of emotion into sign language are discussed. The area of studies is the linguistic part of the Thetos system.

1 Introduction

The Thetos system has been developed since 1998 in the Institute of Informatics at the Silesian University of Technology (Suszczańska et al. 1999, Szmal et al. 2001, Suszczańska et al. 2005). The system consists of two parts: the multimedia dictionary of Polish Sign Language and automatic translator Thetos-3 of Polish texts into Polish sign language. The principal object of this project is to develop computer aided communication between Deaf and Hearing persons. The problems of deaf persons are non-appreciated in society. It is generally accepted that deaf people freely use the Polish language. But it is a problem for the Deaf. Therefore, it is important to develop a communication system, such as Thetos. Moreover, there are two additional objectives: assistance for the Deaf in the learning of the Polish Language, and help for the Hearing in the learning of Polish sign language. That is the aim of the multimedia dictionary and programs that operate it.

The Thetos-3 translator consists of two components: linguistic and multimedia. The linguistic part transforms the input text into intermediate language, composed of Polish words, which are found in the dictionary of the Polmorf analyser (Lubiński 2001) and control signs, which constitute the record of content of the input text. Control signs serve to transfer non-verbal gestures: a pause, directing glance, inclining the head, facial expression, etc. Translation into intermediate language is performed by means of a trivial semantic analysis. The analysis consists of finding the predicate of a sentence and its actants, of which Actor and Object will be mentioned in the article. Semantic analysis is conducted after syntactic analysis of sentences. For that purpose, the Syntactics service of the LAS server¹ (Kulikow 2003) is used. Syntactic analysis is conducted by means of the deep parser Polsyn (Simiński 2007). The representation of sentences syntax is a set of syntactic groups and relations. It is a graph; whose nodes are created by syntactic groups (SG) and whose edges are syntactic relations between the groups. The topology of the graph corresponds with the formalism of the SGS (Gladky 1985) adopted for the formalisation of natural languages (Suszczańska 2003). The structure of SG and the set of syntactical relations are defined by the grammar SGGP (Syntactical Grammar Groups for Polish) (Suszczańska 2005). The automatic generation of the

¹ http://las.aei.polsl.pl/las2
output structure of a sentence and its linearization takes into consideration the syntax of Polish sign language, which differs from Polish syntax. The linguistic part of the translator’s work ends with linearization of the sequence of output sentences in the intermediate language. This intermediate text is automatically interpreted word-by-word by the multimedia part of the application. The result is shown on the screen by an avatar. More information on the Thetos system can be found on the system website 2, where one may acquaint oneself with the work of the system online.

The Speech of the Deaf is full of mime, which is a mechanism for communication 3. Besides, body language is used for transmission of content, which covers more than half of the Deaf message 4. In order for the Thetos system avatar to demonstrate any movements, they must be described in an utterance in the intermediate language. This fact also concerns facial mimicry and body movements, verbal or non-verbal. In order for a description of a mimicking gesture to appear in the output utterance, the reason for the appearance of such gesture must be recognised in the input language. One of such reasons is considered to be the manifestation of emotions and emotional states, which the input text concerns. The paper describes a study of emotion recognition in the text and its translation into the Polish sign language. The area of present investigations is the linguistic part of the Thetos system. The work of the multimedia part of the application is not discussed in the present paper, though we use the expression ‘translation into the sign language’ in the text. We allow ourselves to use it, because the multimedia part performs only the animation of every word or control sign, without changing the content of the translation. The grammar of the intermediate language is not discussed either.

2 Facial expression: lexical and non-lexical

Firstly (up to now), the authors of the translation with the Thetos system are attended mainly to the transfer of verbal content without deep semantic analysis. Such content is transmitted by means of gestures and lexical facial expressions. In this work, the distinction between gestures and mimicry (facial expression) lexical and non-lexical is introduced. The lexical facial expression of the Deaf is such a facial expression, which corresponds to a certain word having the gesture expression in the sign language: please, fine, courteous, unwell, wrong etc. In such case, the translation does not require any additional operations apart from supplementing semantic dictionaries (Bach et al. 2005) with expressiveness features and transferring these features into the output language. Then, every verbal emotive gesture is accompanied by a non-verbal sign, which can even replace the verbal sign itself, as it happens in the case of please.

The non-lexical facial expression means such an expression, which is not associated with a certain word, but with the general semantics of the sentence. Minor attention is paid to non-lexical gestures, because their translation is closely linked to the semantic analysis of these units provided by the syntactic analysis of sentence (see, e.g. Szumska 2000, Langacker 2001). Translation of such texts requires, among other things, drawing up algorithms of deduction and appropriate software; it is also necessary to create specialized semantic dictionaries.

So, emotions are the source of lexical and non-lexical facial expressions. The goal of the study is to establish for research purposes a classification of the mechanisms of the grammar SGGP, which are important for the recognition of emotional states in the text. These units are the package of the syntactic groups with their characteristics.

The next step is concerned the number of emotional states and evaluations accepted for analysis and translation as an utterance by Polish sign language. The parser contains the description of identification of the request to Object (please) and two emotional states: good and bad. We are aware of the fact that an analysis of other manifestations of emotions will result in the occurrence of other characteristics, but the rules of their translation into the sign language will remain unchanged.

2 http://thetos.polsl.pl
4http://www.wikihow.com/Read-Body-Language
3 Classification of emotions and emotional states

The content of this point refers to linguistic research regarding the semantics of names of feelings. Unlike all linguistic, psycholinguistic, philosophical and other researches, listed or not listed in the bibliography, we are not interested in the nature of man, the nature of emotions or the nature of the influence of emotions on man. We are interested in how the descriptions of emotions and emotional states communicated in a text influence the structure of syntactic groups, on which level of syntax modelling you may identify ‘emotional structures’ and how to recognise such structures and translate them into the sign language. In literature there are many approaches to classifying emotions (c.f. Apresjan 1974, Kominek 2006, Nowakowska-Kempna 1995). For example in the work (Wierzbicka 1996) names of emotions are classified in the following way:

- emotions connected with ‘bad beings’ (sadness, unhappiness, distress, upset, sorrow, grief, despair),
- emotions connected with ‘good beings’ (joy, happiness, content, pleasure, delight, excitement),
- emotions connected with people, who behave badly and which are negatively evaluated (fury, anger, rage, wrath, madness),
- emotions connected with feelings (love, hate, respect, pity, envy) (example source: Wierzbicka 1996).

Traditionally, there are three important characteristics of emotional processes: sign of emotions – their positive or negative character, intensity of emotions and content of emotions. In this work, research concerning the sign of emotions is described. The ultimate goal of the research is recognising the content of emotions or emotional state.

We make the following clarifications. The semantic-syntactical classification, presented below, has been developed for the needs of the Thetos system. The classification does not claim to be relevant for semantic description of the Polish language at all, but only for the engineering needs of the Thetos system. Naturally, it has been developed on the base of linguistic groundwork, for example (Libura 2000, Maślowska 1991, Mikołajczuk 1996, Mikołajczuk 2009, Szumska 2000) und other. However, the monograph (Awdiejew et al. 2006) was the most helpful.

The emotions recognition is restricted to two classes: good-bad, which refer to the character of the sign of emotion. Next we model the mime according to these classes. Figuratively, we can depict the models as emoticons :-) and :-(.

3.1 Emotional states and Evaluation

This section will discuss only those cases, in which the meaning of a word refers directly to the name of an emotion. Complex cases will be discussed in point 4.

Two emotional states have been extracted for the translation:
- Good (joyous, merry, happy).
- Bad (sorrowful, angry, unhappy).

In our research it is very important whose emotional state is described in a text: the Actor’s or the Object’s. Proper recognition conditions the gesture that is made. Automatic recognition of the carrier of an emotional state is a very hard task. However, by analysing the components of the GS on all levels of modelling the Actor and the Object, you can try to identify the proper carrier of the state.

For example, if we assume that these states are expressed in text by adjectives, which are a part of the attributive group (GAT) in syntactic representation. In this case the GAT must be either independently represented by noun groups (NG), or syntactically connected with NG, which has the feature to manifest emotions. For example:
- Happy student.

However:
- *Happy cupboard.

The emotional state could be manifested by the noun groups also. In this case the NG is not a carrier of emotional state, but it is connected with the last one, naming it only. For example:
- Joy was awaiting him.
However:
- Joy was awaiting oven.

Therefore constructions permissible in syntactic analysis cannot be interpreted as correct in semantic analysis. The word *cupboard* cannot be the carrier of an emotional state, neither can the word *oven*. Automatic recognition of such constructions is fairly easy. The grammar of recognition must be already set for a given language, for example in the form of semantic dictionaries for every type of GS. Problems connected with recognising non-lexical emotions hidden in the content of a sentence will be discussed in point 4.

We have extracted two types of manifestation of the evaluation similarly to the extraction of the emotional states:
- Good (well, fine, courteous etc.).
- Bad (bad, unwell, wrong etc.).

The evaluations are manifested by the GAT or adverb group (PS), syntactically connected with the sentence predicate (VG). In the first case the evaluation is directed to NG, in the second one – to VG. For example:
- Courteous girl.
- Nice story.

Semantic analysis of the evaluation is also based on semantic dictionaries. The sentence predicate (VG) can also express emotions: like, not like, hate, lie, has been lied to etc.

### 3.2 Request

A request is one of a few emotional manifestations, which is properly automatically recognised and usually transferred to animation. The cases of explicitly or implicitly manifested request are analyzed. An imperative mood is interpreted as a request also:
- Please, Cinderella (*I to ask* you, Cinderella.)
- Bring me the pencil (*you to bring request* pencil here).
- I asked you give me water (*you are request to give I a water*).

A request is a nonverbal gesture; the words *to ask* and a request have the same sign.

You can see the results of request translation into the intermediate language after anonymous log-in on the LAS server and activating the service Thetos.

### 4 Problems of classification of the syntactic representation units

An identification of the units used for emotion expressions is performed after preliminary semantic analysis. A result of this analysis is an argument-predicative structure of sentence. The units of this representation are tagged syntactic groups. Now we focus on the investigations concerned with types of syntactic groups and relations, which identify situations in the text analysed with description of emotional states. Below we are describing several problems closely related to this.

#### 4.1 Emotional states and evaluation

It is very difficult to distinguish the emotional state from evaluation in texts. First of all it is necessary to recognize the unit of the argument-predicative structure due to evaluation. It will be called Object (object of evaluation). Then, we need to recognize the unit of argument-predicative structure making evaluation. It will be called Actor (actor of evaluation). Finally, it is necessary to distinguish between three situations:
- Actor makes an evaluation and expresses emotions at the same time, for example: go away.
- Actor makes an evaluation but does not express emotions, for example: lengthy proving.
- Actor expresses the emotional state and makes an evaluation of the Object at the same time, for example: joyful cry.

Probably, the evaluation appears in a text with neutral vocabulary. Then, it is needed to search for an evaluation among GAT. In this case the analysis is based on the syntactic relations belonged to features of NG, for example, *atr* (Suszczawska 2003a). The analysis requires classification of syntactic relations, which can take place with evaluation expression. In addition it is necessary to
prepare a dictionary of neutral words, which can be the reason for evaluation appearance. However, a problem of recognizing of emotion or evaluation being implicit in sentences remains:

- No, to jest cała moja siostra. (Well, that is how my sister is.)
- Zastanawiam się. (I am thinking about it.)
- To było genialne posunięcie (That was a brilliant move) (Langacker 2001: 61).

As mentioned above, GAT and PS perform similar roles in expression of evaluations or emotional states. But mainly evaluating word is connected by verbal gesture, which must be related to category good-bad.

The following problem is an indication of cases, when the emotions are expressed in text with NG, namely a word womanizer on the one hand gives evaluation to Object, on the other hand expresses the emotions of Actor.

Probably the emotional and evaluating functions can execute the groups of all types. Besides above mentioned examples with GAT, PS and NG, we may present the example with VG: to go – to slip away, to toil along etc.

We do not discuss here the translation of syntactic units used for expressing emotions on default. In this case we refer to the verbal facial expression. We do not consider all cases of requests. Some of them are discussed before, for remaining ones the additional study is needed. We will emphasize that the request-gesture is included to the output utterance automatically after recognition a sentence with a request. If text includes explicit request, for example: I complied with his request, then only one word will be included in the utterance: I comply he request. We would note that two words can be transferred to the animation part: to ask and request, but the meaning is signed by one gesture-emotion: request.

5 Conclusion

The findings described above are now in the phase of realisation.

- As mentioned, a request is automatically recognised and transferred for animation by means of the intermediate language.
- Adverbs in SGGP are basic elements of PS groups. A semantic dictionary of adverbs including 3,500 entries has been prepared for the Thetos system (Bach et al. 2006). Each entry has an assigned set of semantic-syntactic characteristics. Currently, these characteristics are supplemented with codes of emotiveness.
- Verbs form the VG group. The syntactic-generative dictionary of Polish verbs (Polański 1980) for the Thetos system includes about 11,500 entries (Grund 2002). This dictionary will also be supplemented with semantic features required for automatic analysis. For this purpose a special interface enabling remote supplementation of the dictionary has been prepared.
- Similar work is being performed for dictionaries of nouns and adjectives (Bach et al. 2005). This will make it possible to recognise GAT and NG emotive features.

On the basis of the results of initial experiments it can be stated that the problem of application of automatic emotion translation to the sign language is feasible, but in a reduced scope. It may be illustrated by the translation of sentences with constructions that express request. Implementation of the next cases of emotional expression or evaluation needs further investigation. We wish to limit our short-term studies only to translation of the evaluation. These are directions of future investigations:

- The classification of types of evaluation that can be automatically recognized.
- The development of a complete list of types of syntactical groups, which express the evaluation.
- The elaboration of types of syntactical relations, which indicate the evaluation.
- The elaboration of corresponding semantic dictionaries.

Examples given below are very difficult, almost impossible to be analysed automatically. Additionally, emotions in some of the exemplary sentences cannot be framed in the good-bad category.
The translation of Polish texts into the Polish sign language needs the transfer of the most important facts from the text. We believe that the identification of emotions of the good-bad type in a sentence and their translation into gesture is one of the first steps to do this. We are aware that the described studies are not comprehensive, but they can stimulate further research intended to solve the problem of translating emotions into the Polish sign language.

Bibliography

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