Modelling, Measurement and Control C
Vol. 79, No. 4, December, 2018, pp. 162-167
Journal homepage: http://iieta.org/Journals/MMC/MMC_C

Prototype of automatic translation to the sign language of French-speaking Belgium evaluation by the deaf community

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https://doi.org/10.18280/mmc_c.790402

Received: 28 September 2018
Accepted: 31 October 2018

Keywords:
LSFB, machine translation, JA Signing, translate, evaluation

ABSTRACT

This article presents a prototype of automatic translation from French into the sign language of French-speaking Belgium (LSFB). Its main objective is to improve the accessibility of public information to deaf people by means of Virtual Signing, and more specifically, oral information disseminated by loudspeakers placed in stations and trains of the Belgian National Railway Company (SNCB). The application was developed with the Regulus Lite platform, made available by the University of Geneva. Manual and non-manual avatar animations are generated with JA Signing software. The evaluation of the prototype was based on online questionnaires and interviews with members of the deaf community.

1. INTRODUCTION

Information and communication technologies occupy an important place in modern life. In order to participate in this connected society, people with disabilities face a variety of barriers. By making technological equipment more accessible to minorities, the comfort of use for the whole society is increased. For people who are deaf or hard of hearing, audio-visual documentation is increasingly accompanied by textual alternatives, thanks to new subtitling policies. Similarly, information should be provided through sign language, which is a mode of communication used by a significant portion of the deaf community. In the Wallonia-Brussels Federation, we can "reasonably estimate that the number of people needing sign language support is close to 25,000" [16].

Today, several Virtual Signing systems are available and allow automatic translation of information into sign language through virtual characters, also called avatars. In Switzerland, the Trainslate project aims to automatically translate announcements made by loudspeakers in SBB stations for deaf and hard of hearing people [19, 21]. This application is compiled on the Web using Regulus Lite, a platform developed by the University of Geneva.

Our project was to develop a similar prototype, but one that was aimed at a Belgian audience. Indeed, unlike Trainslate, we were confronted with the reality of deaf and hard of hearing people in French-speaking Belgium [3]. We were looking to improve the accessibility of oral information for deaf people on the Belgian railway network, within the Belgian National Railway Company (SNCB). The evaluation was conducted with potential users of the system.

In the following section, we first describe the Regulus Lite platform and the application carried out (section II), then present our evaluation methodology (section III) and the results obtained (section IV), as well as future prospects (section V).

2. REGULUS LITE PLATFORM

Regulus Lite (Figure 1) is a web platform developed at the University of Geneva that allows speech-to-sign language translation applications to be rapidly developed on the web.

Its main benefit is that it can be manipulated by linguists, and not only by computer specialists. It is based on establishing rules that describe the correspondence between the source language (recognized sentences) and the target language (sign language), in the form of Synchronous Context Free Grammars (SCFG) [17-20]. Figure 2 illustrates a simple grammar rule with a parameter for stations ($$gare).

The translation is performed in two steps, namely the Speech-to-sign table translation and the Sign-table-to-SiGML translation [20].

SCFG grammar is first used to make the correspondence between the source sentence and the sign table, which describes the manual (Gloss) and non-manual components needed to animate the avatar (Aperture, etc.) (Figure 2) [19]. The sign table is then converted into a SiGML representation using an HNS lexicon and SAMPA descriptions (Figure 3). The HNS lexicon converts the glosses of the sign table into HamNoSys which describes manual movements (Hamburg Notation System for Sign Languages) [12-13]. SAMPA (Speech Assessment Methods Phonetic Alphabet) descriptions provide lip information (Mouthing) to glosses [22]. Finally, non-manual and non-oral movements are performed using SiGML alphanumeric tags. These play an essential expressive role [2, 7].

Figure 1. Graphical interface

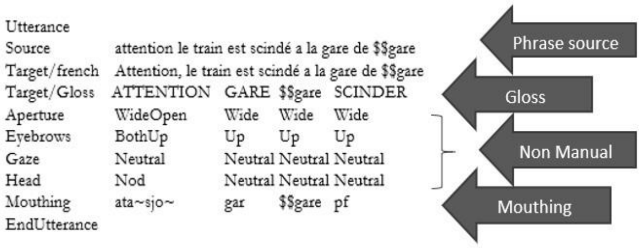

Figure 2. Parametric multichannel grammar rule

The synchronized SiGML representation can then be viewed as an avatar. By this method, it is possible to generate a fully synthesized animation in sign language [5, 8-11, 14].

The current grammar consists of 263 lines, including 7 rules and an HNS lexicon of 157 glosses transcribed from French into the sign language of French-speaking Belgium.

3. METHODOLOGY

3.1 Goal

We wanted to know if the avatar could solve communication problems in the public environment, and to evaluate its comprehensibility and usability. To do this, we wanted to have the opinion of the deaf community about the proposed technology, as well as that of public authorities, and to question a population that is representative and potentially interested, or at least concerned about this issue in public spaces, and more precisely, in the rail system.

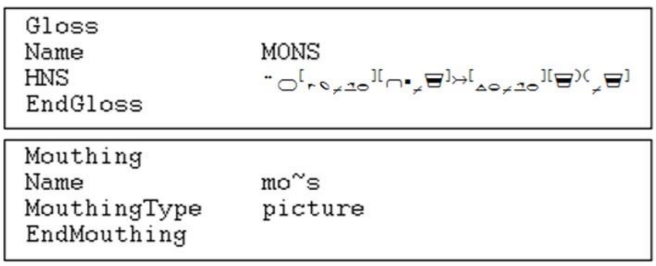

Figure 3. HNS and SAMPA representation ($$ station: MONS)

To begin with, it was important for us to be familiar with the profile of the participants, and their opinions and experiences in trains. In order to do this, we created an online form that was distributed on social networks (see Section 3.2). The interested and selected persons were then invited to participate in interviews on the comprehensibility, potential and usability of the prototype (see Section 3.3).

3.2 Selection questionnaire

The selection questionnaire was designed to determine the profile of participants and to find people for the user test. Since it had to include a video playback option, we used the *Google Forms* tool. Our form consisted of five parts:

- *Profile* (6 questions: name, profession, age, town, contact, email),
- *Deafness* (5 questions: level, circumstances, sign language, oralist),
- *General knowledge* (3 questions: reading, computers, technology),
- *Train and accessibility* (4 questions: frequency, accessibility, adapted services)
- *Scenarios* (6 practical cases). We could distinguish between simple questions (name, address, telephone, e-mail) and multiple choice questions (age range, train use), as well as open-ended questions.

The originality of our questionnaire was that it was both in French and in the sign language of French-speaking Belgium. In order to carry this out, we called on the team from the *Centre francophone de la langue des signes* (CFLS). These video information dissemination professionals provided recording equipment and facilities. We also had the help of a presenter, interpreters and technicians (Figure 4).

Figure 4. Centre francophone de la Langue des signes

After some editing operations, the standardized videos were placed in the Google Forms questionnaire, along with the written formulations. The questionnaire was then distributed on social networks, in particular on forums of the *Fédération francophone des sourds de Belgique* (FFSB), as well as to private groups with links to accessibility, deafness and public transport. The results arrived within a few days. Sixteen people with hearing impairments agreed to answer the entire questionnaire (twelve Deaf, three Hard-of-Hearing, one Usher-Syndrom).

3.3 Interviews and user tests

Subsequently, five interviews, two individual or three grouped, were held to assess the potential of our prototype machine translation application [6]. Fifteen people were invited to test the prototype in an interview. They belong to different associations or institutions related to the deaf world, namely *Escale* asbl (5), *Centre Comprendre et Parler* (5), *Surdi Mobile* asbl (1), *EBISU* asbl (3) and *Musée sur Mesure* (1)

For this purpose, individual and group meetings were set up with some representatives of the deaf community in Belgium. Most of the interviews were organised in participating associations or public spaces, such as a railway station. After initial contact, we followed a particular order of presentation:

1°) Presentation of our case study
2°) Test of comprehension
3°) Usability testing
4°) Post-task maintenance

The first stage of the experiment was to present the different working methods for disseminating information in sign language (motion capture, video capture, algorithmic avatars, etc.). We wanted respondents to understand the value of this tool as part of our research.

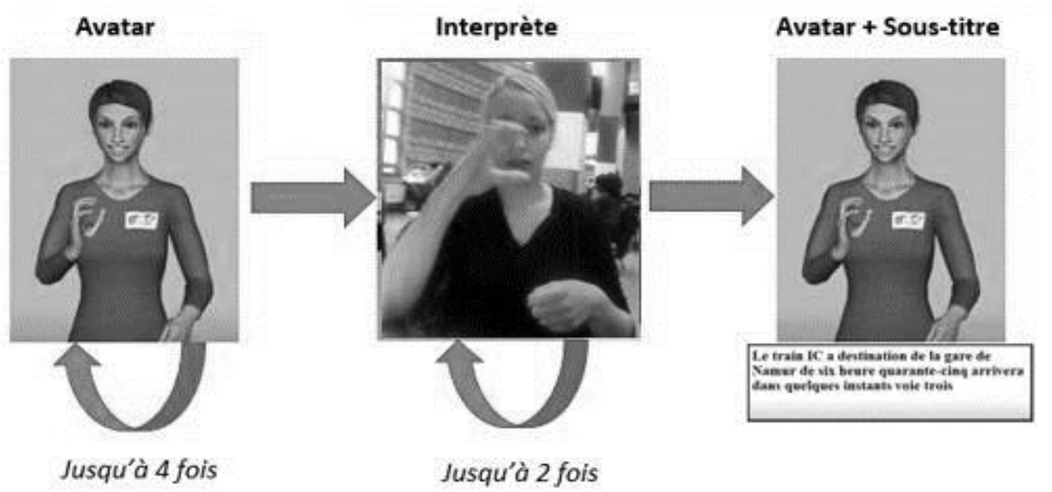

Figure 5. Delta testing with Sefora Farinelli (interpreter)

The first test (comprehensibility) consisted in showing several videos that repeated the same sentences signed both by our avatar and by a sign language interpreter. The sentences were chosen to reflect some obvious characteristics of the railway environment, such as a train split, a track change or an (in) definite time delay. At the end of each viewing, the tester had to give his opinion according to the Delta testing method, which allows us to compare the two approaches and to evaluate the aesthetics of an avatar compared to a human signer, its speed of execution, its physical appearance and its expressiveness [4, 15]. It also aims to determine the level of comprehension of sentences and possible transcription errors (Figure 5).

The second written test was related to the usability of our translation system. Using a value scale, some questionnaires can measure a person's appreciation and satisfaction with an electronic system. This is what Brooke offered us with its System Usability Scale [1]. Of the ten questions asked, the tester had to provide a number between 1 (--) and 5 (++). This scale provides a usability and overall usability score for the system. Quick to run and simple in form, the System Usability Scale (SUS) is widely regarded as a reliable questionnaire and can confirm other more specialized indicators (Figure 6).

The post-task interview consisted of a conversation in which we discussed various topics related to our theme, including the potential of using avatars in other areas.

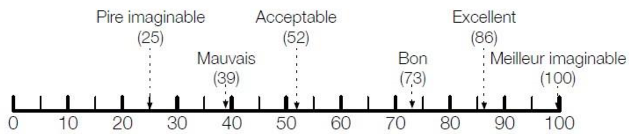

Figure 6. System usability scale

4. RESULTS

4.1 Profile

The participant selection questionnaire allowed us to identify a representative population for our study. Sixteen people with hearing impairments who agreed to answer the entire questionnaire, provide us with their experiences and opinions on accessibility in railway public spaces.

All age groups, various professional backgrounds, and most of the French-speaking provinces of Belgium are represented. Eighty percent of those interviewed, or thirteen people, are "profoundly deaf", two are partially deaf and one has Usher syndrome.

4.2 Railway experiences

As far as their train travel is concerned, our panel included occasional passengers, as well as some commuters. Their experience with the network gave legitimacy to their words.

A number of participants welcomed the initiatives and improvements to the rail network in recent years. Five people agree that the installation of computerized signs on each track and in trains is essential in the event of incidents. The screens showing all routes with lanes and delays are also among the initiatives that were particularly useful and welcomed by the participants in the survey. The large stations were positively evaluated in terms of accessibility, in particular that of Brussels-Luxembourg.

However, more than half of the participants considered that the facilities of the SNCB rail network are poorly adapted to deaf people (43% dissatisfied, 25% seeing little improvement in adaptation). One of the main criticisms has to do with the loudspeakers. Two people with implants pointed out to us that most of the announcements made by loudspeakers are, for them, incomprehensible. The information they receive is partial; they are obliged to double check what they have heard by reading the written announcements, or by asking SNCB staff.

According to those who are not equipped, there is a glaring lack of visual information at all levels of a train journey. Unforeseen events (e.g. lane changes) are often only announced via station loudspeakers. The situation is similar in some old trains. Unlike larger, more accessible stations, rural or outlying stations often lack information signs. Some assistance services and contact points do not take deaf people into account, as they can only be contacted by phone.

New technologies are used by many people to keep informed (Figure 7). Thus, to know train timetables, the majority of our users connect to the smartphone rail application or do a search on the SNCB website. Only about a quarter of the participants go to the station counter to get information.

Moyens de s'informer	Nombre de réponses
Site web SNCB	13
Application SNCB	11
Renseignement au guichet	4
Ne se renseigne pas avant	3
Accompagné	1

Figure 7. Questionnaire: How to get information in a station

However, it was noted that obtaining information from SNCB staff is not automatic, nor spontaneous for the deaf public. Indeed, a language barrier often hinders this type of contact. Some alternatives exist, such as oralisation (50%) or writing (37.5%), but most often, passengers do not reach out to the train attendant (43.8%). Opinions are quite divided with regard to the relationship that a deaf person may have with a member of the SNCB staff. There is clearly a lack of awareness and training in sign language. Counter attendants are considered more affordable compared to train attendants, who often lack patience, empathy or knowledge for deaf people.

The data collected was limited to a small panel of deaf participants. However, the results remain interesting at our level. Several observations can be made. Some personal characteristics are recurrent, such as the use of sign language, oral language as an alternative, mastery of the written French language and the use of trains.

4.3 Comprehensibility

Fifteen people participated in the comprehensibility test, three of whom had responded to the initial questionnaire. The common point among the speakers was that they all mastered one of the two sign languages of Belgium, and have an affinity with new technologies. Interviewees repeatedly made several remarks about the comprehensibility of the avatar:

4.3.1 Naturalness

All the speakers felt that the virtual character was too rigid. This was particularly noticeable in the wrists, which do not accentuate hand movements enough. The end of each signed statement was also unnatural. Indeed, the virtual character suddenly stops without returning to his initial starting position, i.e. hands along the body.

4.3.2 Rhythm

Generally speaking, the sentences signed by our avatar had rhythmic and speed problems. Either too fast or too slow, we were occasionally asked to pause so that the tester could assimilate essential information, such as the announcement of a train entering the station or an hour of passage.

4.3.3 Expressiveness

The expressiveness of the body, although limited, was appreciated. Some words or expressions were correctly produced using head movements or more insistent looks. The negation of a sentence was particularly well represented, as well as the notions of caution through the avatar's gaze.

4.3.4 Scale

Several people observed that the avatar's hands were not proportionate to the rest of the body. Indeed, they were larger than the rest of the body, which was appreciated because they were thus valued on the screen. It was suggested that colours could be accentuated to distinguish the back of the hands from the palm.

4.3.5 Position

As for position, users proposed an initial three-quarters position and pushed us to consider more lateral movements to give depth to the avatar. The lower body being little used, the avatar could monopolize the screen from his navel, and not from his thighs.

4.3.6 Contrast

The contrast between the colour of the avatar's clothing and skin was mostly accepted. A deaf commuter pointed out that it would be more pleasant to see the animation in the SNCB colours.

4.4 Usability

Three associations (eight individuals) agreed to respond to the SUS. The three members of the Escale obtained a score of 71.57%; the four professionals of the Comprendre et Parler centre obtained a score of 77.5% and the representative of Surdi Mobile 70%.

Due to time constraints, it was not possible to administer the usability test to all participants. Moreover, for linguistic reasons, we did not distribute this form to EBISU ASBL. The complexity of the turns of certain phrases prevented us from reproducing the test in Dutch.

Analysis of the SUS results reveals that most participants consider our prototype to be a good improvement, but one that still requires some adjustments. This equates to a usability score of 70 to 78%.

4.5 Post-task usability maintenance

The interviewees all agreed that this technology could also meet other very specific needs when human interpreters cannot intervene on a daily basis. As far as public transport is concerned, we concentrated on the SNCB case, but other circles are confronted daily with oral announcements (STIB, TEC, airport, etc.). Beyond the simple perspective of an advertiser, this type of system can also prove useful as an alert announcer. Thus, a wallpaper that differs from the usual image can also be added in case of danger (red color, exclamation mark). This could also be provided for CVO alerts (nuclear, chemical, etc.).

For the hospital sector, the answers remain mixed. During a medical consultation, some people consider the presence of a human interpreter to be reassuring, as a medical intermediary. The presence of an avatar is more relevant in waiting rooms or at the information desk.

For the museum community, the opinion of *Musée sur Demande* was significant. When contacted, the representative considered that it would be interesting to install an automated sign language system. Indeed, he pointed out that this type of system would facilitate the movements of deaf people in museums, in addition to the obligatory presence of interpreters who propose guided tours of the exhibition spaces. Near the security gates, cash registers and changing rooms, an avatar could provide support to the guards when they have to perform other tasks (excavations, surveillance, etc.).

5. CONCLUSION

This article presented the results of the evaluation of an automatic translation system developed for the Belgian railway network by members of the deaf community using the sign language of French-speaking Belgium.

The aim of this work was to observe the target audience's use and acceptance of a prototype rail announcement using a JASigning avatar translating calls, usually spoken, in real time.

These evaluations allowed us to identify a number of areas for improvement. These included problems of form or background, or those relating to the physical nature or expressiveness of the avatar, etc.

Although our results concern the application of such a system in the rail network, our testers considered that this type of technology could be useful for the entire rail and airborne network, as well as for emergency messages (CVO alert, traffic information, etc.). Waiting rooms could also develop information content (museums, hospitals, sports events, etc.). Generally speaking, the avatar can fill a gap in any public space without interfering with the work of interpreters.

REFERENCES

[1] Brooke J. (1996). SUS: A quick and dirty usability scale. In Jordan PW, Thomas B, McClelland IL, Weerdmeester B (ed.). Usability Evaluation in Industry, CRC Press, Londres, United Kingdom, pp. 189-194.

[2] Crasborn OA. (2006). Nonmanual structures in sign language. Encyclopedia of Language and Linguistics 8: 668-672. http://hdl.handle.net/2066/42832

[3] David B. (2017). Traduction automatique de la parole vers la langue des signes de Belgique francophone. Codage d'un avatar destine aux transports en commun belges. Université Libre de Bruxelles, Bruxelles, Belgique.

[4] Ebling S. (2013). Evaluating a swiss German sign language avatar among the deaf community. Proceedings of the Third International Symposium on Sign Language Translation and Avatar Technology, Chicago, United States of America, Octobe. https://www.researchgate.net/publication/276757609

[5] Ebling S, Glauert J. (2013). Exploiting the full potential of jasigning to build an avatar signing train annoncements. Proceedings of the Third International Symposium on Sign Language Translation and Avatar Technology, Chicago, United States of America, October 2013. https://www.researchgate.net/publication/276757820_Exploiting_the_Full_Potential_of_JASigning_to_Build_an_Avatar_Signing_Train_Announcements

[6] Ebling S. (2016). Automatic translation from german to synthesized swiss german sign language. University of Zurich, Zurich, Swiss. http://www.zora.uzh.ch/id/eprint/127751/1/ebling-2016c.pdf

[7] Ekman P. (1992). Facial expression and emotion. American Psychologist 48(4): 384-392. https://www.paulekman.com/wp-content/uploads/2013/07/Facial-Expression-And-Emotion1.pdf

[8] Elliott R, Glauert J, Kennaway J. (2004). SiGML notation and SiGMLSigning system. University of East Anglia, Norwich, United Kingdom. http://www.visicast.cmp.uea.ac.uk/eSIGN/Images/Flyer_SiGMLSigning.pdf

[9] Elliott R, Glauert J, Kennaway J, Marshall I, Safar E. (2008). Linguistic modelling and language-processing technologies for avatar-based sign language presentation. Universal Access in the Information Society 6(4): 375-391. https://doi.org/10.1007/s10209-007-0102-z

[10] Glauert J, Elliott R. (2011). Extending the SiGML Notation – a Progress Report. Second International Workshop on Sign Language Translation and Avatar Technology, Dundee, United Kingdom, October 2011. http://vhg.cmp.uea.ac.uk/demo/SLTAT2011Dundee/8.p

df
[11] T. Hanke, G. Langer, and C. Metzger. (2001). Encoding nonmanual aspect of sign language. In T. Hanke (ed.), Interface definitions. ViSiCAST Deliverable D5-2.
[12] Hanke T. (2004). HamNoSys – representing sign language data in language resources and language processing contexts. In O. Streiter and C. Vettori, (ed.), Sign Language Processing Satellite Workshop of the Fourth International Conference on Language Resources and Evaluation, Lisbon, Portugal, May 2004. http://www.lrec-conf.org/proceedings/lrec2004/ws/ws18.pdf
[13] Hanke T. (2007). HamNoSys – hamburg notation system for sign languages. Institute of German Sign Language.
[14] Jennings V, Elliott R, Kennaway R, Glauert J. (2010). Requirements for a signing avatar. Fourth Workshop on the Representation and Processing of Sign Languages: Corpora and Sign Language Technologies, University of East Anglia, Norwich, United Kingdom. http://www.academia.edu/2348900/Requirements_for_a_signing_avatar
[15] Kipp M, Heloir A, Nguyen Q. (2011). Sign language avatars: Animation and comprehensibility. In Vilhjálmsson HH, Kopp S, Marsella S, and Thórisson KR. (ed.), Intelligent Virtual Agents 6895: 113-126. https://doi.org/10.1007/978-3-642-23974-8_13
[16] Martin A. (2017). Interprètes en langue des signes : un manque criant en Belgique. Le Soir, Février. https://references.lesoir.be/article/interpretes-en-languedes-signes-un-manque-criant-en-belgique-/?TrackID=3#sc=socialmedia&me=socialmedia&cm=0
[17] Rayner M, Armando A, Bouillon P, Ebling S, Gerlach J, Halimi S, Strasly I, and Tsourakis N. (2015). Helping domain experts build phrasal speech translation systems. In J. F. Quesada, F.-J. M. Mateos, T. Lopez-Soto (ed.), Future and Emergent Trent in Language Technology, Sevilla, Spain, November 2015, pp. 41-52. https://link.springer.com/book/10.1007/978-3-319-33500-1
[18] Rayner E, Baur C, Bouillon P, Chua C, and Tsourakis N. (2016). Helping non-expert users develop online spoken CALL courses. Workshop on Speech and Language Technology in Education (SLaTE), Leipzig, Germany.
[19] Rayner E, Bouillon P, Ebling S, Strasly I, and Tsourakis N. (2016). A framework for rapid development of limited-domain speech-to-sign phrasal translators. 12th International Conference on Theoretical Issues in Sign Language Research (TISLR12), Melbourne, Australia. http://archive-ouverte.unige.ch/unige:79988
[20] Rayner E. (2016). Using the Regulus Lite Speech2Sign Platform. http://www.issco.unige.ch/en/research/projects/Speech2Si gnDoc/ build/html/index.html
[21] Trainslate. Université de Genève, Mars 2017. http://speech2sign.unige.ch/en/applications/trainslate/
[22] Wells JC. (1997). SAMPA computer readable phonetic alphabet. In D. Gibbon, R. Moore, and R. Winski, (ed.), Handbook of Standards and Resources for Spoken Language Systems, Berlin, Germany – New York, United States of America. http://www.phon.ucl.ac.uk/home/sampa/