Online French Sign Language (LSF) classification system: from LSF to French

P. Foucher, C. Moreau, C. Robalo, C.Tranchant, N. Zouba, J. Lopez Krahe.
Laboratoire Technologies, Handicaps, Interfaces et MultiModalités de l'Université Paris8 (THIM)
2, rue de la liberté, UFR6 A146, 93526 SAINT-DENIS, France.
{pfoucher, jlk@univ-paris8.fr} ; cedric_m@laposte.net ; c.robalo@yahoo.fr ;

Abstract
This article concerns the development of a Multimedia dictionary, which aims to translate a part French Sign Language into French from the description of the sign. The creation of this dictionary needs some studies to elaborate a classification system making possible to find a sign from a previous ordering. This classification must take into account the specificity of the sign language. At the moment three elements are used to describe the sign: configuration, localization and movement, but other elements (look, face, body orientation) may be considered in the future. The dictionary is available on a free website. The results show the difficulty of the task since many configurations are quite similar. Investigations may be lead to consider the similarities between the actual sign and the sign given by the user.

Keywords: French Sign Language, classification, Hearing impaired people, website.

I. Introduction

In France, many people including hearing-impaired and deaf community and their friends and families use French Sign Language (LSF). As other foreign sign languages, LSF is a language and cannot only be considered as a simple transcription of French tongue in the visual-gesture space. The learning of LSF needs the knowledge of the grammar, the syntax, the vocabulary, etc... Particularly, the use of a dictionary makes possible the research of the word meaning using a definition, a translation, a synonymous or an etymology…. Each dictionary is based on a classification system to research easily and quickly a word. This classification is for example based on roman alphabet for many tongues (French, English) and does not pose any problems for literate people.

In the case of the LSF sign research, people must previously know the French word to find the meaning. This situation is highly complex and it appears interesting to do research works for proposing an LSF classification system.

This dictionary could propose the definition or the translation into other tongues (such as French) of a sign from the description of this sign. The creation of this dictionary needs some studies to elaborate a classification system making possible to find a sign from a previous ordering. This classification must be based on the elements describing the sign (configuration, localisation, movement …) and must also take into account the similarities between two signs in order to manage eventual differences between the actual sign and the sign given by the user.

This paper presents a part of a global project concerning the development of online and free dictionary that translates vocabulary from French to LSF and inversely from LSF to French. At the moment, the first part of the dictionary (translation from French to LSF) is available online[1]. The second part of the dictionary concerns specifically this article. Actually, this current contribution aims also to explain the complexity of a problem that could appear initially fairly simple. This contribution is organized as follows. In the section 2, the authors explain the general presentation of LSF (needs, lexicology, gesture description, signs parameters). Section 3 describes the software architecture and the classification system This section concerns also a reflection about fuzzy classification when the sign is partially or wrongly perceived. Section 4 concerns experiments, training validation tests and discussion. Finally conclusions and future works are drawn in section 5.

II. LSF Presentation

A. Linguistic Analysis

A French Sign Language analysis is necessary to create a classification system and determinate the more efficient parameters. This research uses a strategy based on the description of the standard signs that are gathered in the dictionaries. The sign is composed of the following parameters: configuration, localisation, orientation, movement, and face expression. Initially, only three parameters of a Sign Language (American Sign Language) had

[1]http://ufr6.univ-paris8.fr/desshandi/supl/projets/site_lsf/accueil/accueil.php

been found by Stockoe *et al*. [1]. The orientation have been added by Friedman [2] and Liddell [3] and the face expression by Moody [4]. The signs are realised in a signing space corresponding to a quarter-sphere, solar plexus-centred [5].

B. Interface for sign language

Some researches have concerned sign description, sign encoding and sign synthesis since thirty years. A review of works on specific multimedia tools destined to sign language has been made by Losson [6] of whom the research leads to the realisation of virtual signing software.

The improvement of new technologies has made possible the development of multimedia dictionary such as Wilcox and Scheibman [7], Neve *et al.* [8] and Bonucci [9]. Thus Wilcox and Scheibman [7] propose the Multimedia Dictionary of American Sign Language (MM-DASL) which give the possibility to translate words from ASL to English using the description of the sign. The particularity of this dictionary is the "fuzzy search" for which the user specifies a similarity level between the real sign and the input parameters.

The DILS "*Dictionnaire Informatisé en Langue des Signes" is* a computerized sign language dictionary proposed by Neve *et al.* [8]. It gives a very complete information on LSF signs (definition and use in a context, synonymous, videos, illustrations…). There are two access possibilities: alphabetic order and signs parameters. A part of PhD research of Bonucci [9] consisted in a data basis development making possible research from textual items or iconic representation. Those last two applications are available on CD-ROMs.

This state of the art is not exhaustive and many other interfaces for Sign language or Multimedia dictionaries have been implemented.

C. Problematic

Actually, this research implies three kind of problematic. The first problematic depends on the specificity of Sign language. Indeed, it is not an easy task to describe without give information concerning the grammatical structure of the LSF. At the moment, the dictionary is limited to the gesture (hand) description of the standard signs [10] However, other parameters, such as look, body orientation, face and pointing, allow the sign comprehension. This project must be considered as a basis for elaborating a multimedia tool to learn sign language.

Another difficulty relative to the LSF is that there is no official institution to standardize the French Sign Language. Some French associations or schools try to propose normalization but nothing is definitive.

The second problematic concerns the classification system, which must consider a combination of five parameters (actually, this solution has been developed using only three parameters). Confusions between two elements of the same parameter (two localisations, two configurations…) lead to a false definition of the sign or an impossible combination. The system must take into account this error probability and propose an adaptive classification according to the similarity level between signs combinations. The main difficulty is yet: How measure a similarity between two signs? How take into account this similarity into the final result?

The third problematic concerns the Human machine interface. Particularly deaf people must have the possibility to consult the different applications by proposing a LSF access.

III. SOLUTION DEVELOPMENT

The objectives of this application are multiple: (1) research the definition of a written word from the description of the sign in LSF, (2) obtain LSF videos of the researched signs, (3) propose to deaf people sign research system in LSF. At the moment, the research concerns mainly the first point.

The solution must take into account three main criteria:

- It is a free application
- It is destined to a general public and must propose thus an easy exploration and use.
- The website is accessible to hearing impaired people. Objectives, instructions and helps have been translated into LSF.

A. Parameters

The sign modelling may consider the five parameters. Actually, our solution uses only three parameters: the configuration, the localization and the movement.

The configuration corresponds to the hand shape and the exact disposition of fingers to do the sign (fig.1). There is not any standardized and official inventory of configurations for LSF [11]. The number depends on the definition of the configuration, the variation between two configurations…Boutora [11] proposes to compare the various inventories which include between 39 and 130 configurations. This research uses the 60 configurations found by Segor [12].

Fig.1: Example of configuration

The localization is the sign position relatively to the signing person. There can be a contact between the body or not. By using an existing avatar [13], a model makes possible the localization of the sign in the signing space. This model divides the signing space into sub-spaces disposed in the front of user. Thus, three horizontal divisions, three vertical divisions and three forward divisions give 27 sub-spaces. (There is no sign behind the user). In the localization models, the user's point of view is the same as the speaker's point of view. The Human Machine Interface proposes to the user two signing space models. The first model (fig 2a) is a two times representation (in front of the user with nine sub-spaces and from a zenithal projection with nine sub-spaces). The second model (fig 2b) is a 3D representation of the signing space. This second model seems to be more adapted for people who know very fluently sign language.

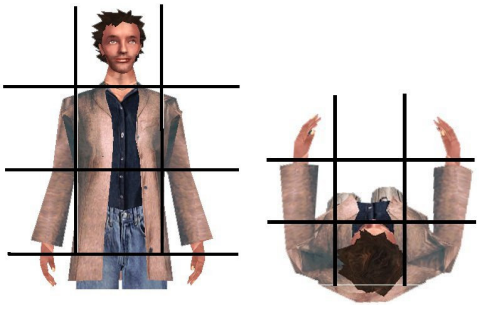

Fig.2a: Sub-spaces division (1st model)

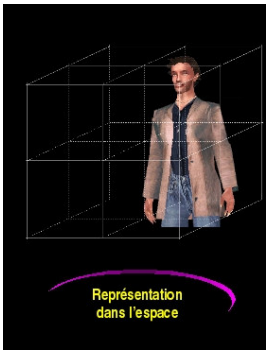

Fig.2 b: Sub-spaces division (2nd Model)

The movement is realized by fingers, hands, wrists, arms separately or together. The movement consists either in a simple movement (horizontal or vertical) or in a complex movement (same movement with hand closing, fingers vibrations, wrist rotation,…). The movement is characterized by speed, direction and trajectory. Actually, the movement model is highly simplified. It considers only the determination of starting point, intermediate point, ending point and configurations changes between those localization points.

B. Sign research

The site makes possible a research of LSF vocabulary by describing the sign. Firstly, the user selects a configuration. The choice concerns then the localization of the sign using a model (2D models or 3D model). Figure 3 outlines the used classification system.

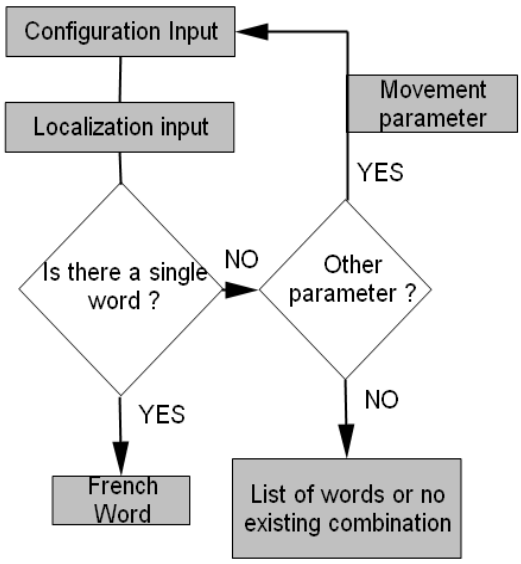

Fig.3 Classification system

Training is the preliminary step to define the parameters corresponding to each sign. The classification step consists in comparing each parameter given by the user with all the signs parameters determined by the training. At the moment, the matching is realised if the input parameters correspond to the real parameters exactly.

Actually, the main objective of this research is to realize a measurement of similarity. In such a way, studies are in progress in order to perform a classification system that proposes different word possibilities in relation to the resemblance between two descriptions in terms of hand configuration, localization and movement. The possibilities may consist in a "distance" calculation, which considers both configuration similarity and spatial neighbourhood. This distance makes possible the display of different translations depending on their potentiality.
Thus, a confusion matrix (table 1) has thus been elaborated giving the distance between two hand configurations (numbered from 1 to 60). People who know very well French sign language have estimated the distance empirically. In this table, the distance varies from 0 to 9. A low distance corresponds to two similar configurations.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	0									
C2	3	0								
C3	1	3	0							
C4	2	3	2	0						
C5	2	3	2	2	0					
C6	5	5	5	5	5	0				
C7	6	5	6	4	4	4	0			
C8	9	6	9	9	9	6	7	0		
C9	7	8	7	7	7	5	2	4	0	
C10	6	5	5	5	6	4	3	6	4	0

Table 1: Confusion matrix of hand configurations (the first 10 configurations)

The calculation of a spatial distance in the signing space allows considering the localization approximation. The Euclidean distance appears as the simplest distance model but it does not take into account the heterogeneity of signing space in terms of probability of localisation. For instance, only few signs are made in the "bottom-forward-left" sub-space.

At the moment, the implementation of the similarity calculation is not finished. No results have been yet obtained.

C. *Website application*

The general website is composed of three levels. Human Machine interface processing system level and Data Basis level using a DBMS (DataBasis Management System).
At the end, the system proposes a video of the sign corresponding to the found word.

IV. RESULTS

Twenty words of the dictionary have been tested. In those tests, a video of the sign is presented to a user as many times as he wants. The user, who does not know French Sign Language, tries then to research the translation using the parameters: Hand configuration, localisation and movement. The result given by the website is compared to the real translation of the word. The results are given below (table 2).

Good translation	Mistranslation	No existing combination
25%	10%	65%

Table 2: Percentage of good results

At the moment, the results are insufficient; the percentage of good results is 25%. However, only few mistranslations can be notified. The main errors are due to the similarity between two parameters (configurations or localization) and result in no existing sign combination. Actually, two confusions types appear:

- Some hand configurations could appear very similar (fig. 4) in relation to the orientation of the hand during the sign. However, this problem is partially settled by observing attentively several times the hand configurations on the videos.
- Actually, the major difficulties come from the localization for which two problems exist: the localization is insufficient to discriminate two signs. It is really difficult to make a modelling of the actual sign localisation in the divided signing spaces. It seems that people who know sign language have less localisation problem than other people. It could thus have an interest in proposing a training to help the user to localize the sign in the signing space

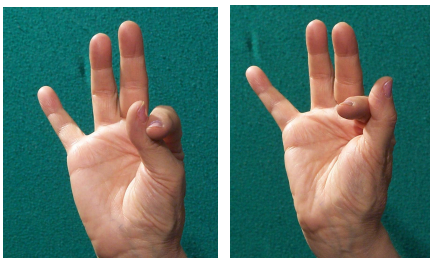

Fig. 4: Examples of two similar hand configurations

Other tests must be realized considering the variety of words and the population (deaf people, people who know LSF and people who do not know LSF).

This application involves some ways to translate words from LSF to French. The development of this tool takes into account the specificity of the sign language and particularly the difficulty to separate vocabulary and context. This approach could thus appear frustrating and insufficient for many users and particularly for users who know very well LSF.

V. Conclusion

This research shows the difficulties to develop an online Sign language dictionary. Despite the insufficient results in terms of percentage of good translation, this research gives encouraging orientations concerning classification systems for sign language, similarities measurement and analysis.

Some difficulties appeared: signing space is heterogeneous in terms of probability, some movements are furtive but significant, and many problematic have been raised up concerning the function of this dictionary, the interest of computerized tool for sign language learning.

At medium term, this research aims at developing the application considering the similarity degree between two signs. Collaborative works between computer scientist and sign language specialists would improve efficiently our solution

Acknowledgements

We would like to think Josette Boucheveau, Maurice Duhayer and Jean-François Morinière for their helps for LSF and hand configurations videos.

VI. References

[1] W.C.Stockoe, D.C.Casterline, C.G.Cnroneberg, A dictionary of American Sign Language, Washington, D.C.: Gallaudet College Press 1965

[2] L.Friedman, On the other hand, new perspectives on American Sign Language, New York, Academic Press, 245 P. 1977.

[3] S.K. Lidell, American Sign Language Syntax, Mouton Publisher, 1980

[4] B.Moody, Histoire et Grammaire, tome I, Ellipses, Paris, France, 1983. (in french)

[5] E.S.Klima, U.Bellugi, The sign Language, Harvard univeristy Press, Cambridgen 1979

[6] O.Losson, "Modélisation du geste communicatif et réalisation d'un signeur virtuel de phrases en langue des signes française" PhD, Thèse de doctorat, Université Lille1, 2000 (in french) .

[7] S. Wilcox, J.Scheibman, "Multimedia dictionary of American Sign Language", Proceedings of ASSETS, Association of Computing Machinists*., pp 9-16,*

[8] F.X.Nève*,* D.Stassart, J.Robert " Dictionnaire Illustré de la Langue des Signes Française", Céplus, Bordeaux, CAPSAS, on CD-Rom, 1998.(in french)

[9] A.Bonucci, "Analyse phonologique et indexation figurative pour une base de données d'entrées lexicales de la langue des signes française". PhD, Thèse de doctorat, Université Lyon 2, 1998 (in french)

[10]C. Cuxac, La langue des signes française (LSF), les voies de l'iconicité, Faits de Langus, 15/16, Ophrys, Paris, 2000

[11] L.Boutora, "Une perception catégorielle des configurations manuelles de la LSF, Définition et caractérisation des unités de l'inventaire des configurations " Colloque international LSF, Lille, France, 12-16 Juin, 2006 (in french)

[12] M.Segor, "Réalisation de messages en LSF dans le contraintes physiologiques liées à la situation ", Mémoire de DEA, Université Paris8, France, 2005 (in french).

[13] Avatar Studio 2.0 de Canal+ Multimedia.