Automatic sign language recognition: a social approach

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Abstract

This paper reviews the social needs of the deaf community and describes the mechanisms and/or technologies which would improve the quality of life of this collective. The basis of this project is a teleinterpretation pilot, developed in Andalusia (Spain), and as a result of the interaction with the users, two investigation lines have been discovered, telephone communication, and e-learning. These activities have a clearly defined technology need by the hearing impaired, and existing solutions do not completely solve the problem, therefore they are a good scenario to implement an automatic sign language recognition system. The aim of the paper is to demonstrate how to thanks to this technology, social barriers can be torn down, allowing equal access to those services that today are restrictive for deaf people.

1. Introduction

In a multicultural world where people are in constant movement and distance is no longer a problem, the definition of the word ubiquitous has increased its meaning. In this context, it is of vital importance to ensure that the groups at risk of exclusion, including deaf people, have access to new communication technologies.
By developing the appropriate tools, such as automatic sign language recognition systems, these technologies can promote the elimination of existing communication barriers, providing mechanisms for social integration.
With this target in mind, the platform of communication for deaf people was born; not only as a tool to resolve the problems of distance, but also to improve the quality of life of the deaf, adding new and promising possibilities to their standard methods of learning, signing, and interaction with hearing people.
The platform has two main focuses: on one hand it would constitute help to the traditional system of sign language interpretation, in cases where an interpreter is unable to reach the place where the deaf person is, or even when the demand for interpreters supersedes the number on hand.
On the other hand we have the learning of sign language: reducing the difficulties to link a SL signal with a written word and promoting the early communication in an effective way between hearing parents and deaf children, allowing the linguistic, psychological and social development of these children to be easier.
The awareness of the importance of sign language and the methods used today to teach it is an important research issue in Europe and this is where the platform must demonstrate its advantages and provide its services, not only to a individual but also for groups of e-learners.
This system relies on new communications research, such as New Generation Intelligent Networks (NGIN), Voice over IP (VoIP), advanced videoconferencing techniques and network integration (3G, analogical telephony, IP telephony, internet applications).
The addition of an automatic sign language recognition system will allow the deployment of a variety of unattended SL services, easily accessed. This tool will play an important role in the current technological environment, disseminating the use and knowledge of sign language and encouraging people participation.

1.1 Spanish Sign Language

Spanish Sign Language, being the languages of the deaf and deaf-blind who have opted for this modality linguistics, have not had the recognition, nor proper development, and despite the fact that numerous investigations carried out nationally and internationally have shown that sign languages meet all the requirements of natural language and possess a grammatical syntasis and lexical features of its own. Recently this situation has been corrected and proof is the adoption of many standards, including most notably several Statutes of Autonomy, who recognize the importance of sign languages.

One example of the importance of sign language is the number of users of sign language is Spain, approximately 400,000 of which 100,000 are deaf. (CNSE, 2010).

Sign language is the main pillar on which underpinned services, created for the ease of social integration of deaf people, as it will be the medium used for convergence communication between users of services, both hearing users and hearing impaired.

1.2 Interpretation

In Spain there are a total of 2,781 sign language interpreters, accredited professional training among non-formal and formal training graduates, of which about 25.17 percent are active.

According to this data, in Spain, the ratio of sign language interpreters there is a professional for every 143 people who are deaf or hearing impaired (SID, 2010).

Recently, the Federations of the National Confederation of Spanish Deaf (CNSE) voiced the need to incorporate sign language interpreters into public life, the creation of the Center for Linguistic Normalization of Spanish Sign Language and to promote learning. These claims are part of the manifesto drawn up for the celebration, last September, the International Day of Deaf Persons.

The confederation requires full accessibility to the audiovisual contents through subtitling and to incorporate content broadcast in sign language, so therefore "are guaranteed the rights of all deaf people to receive information, for the enjoyment of leisure and culture".

1.3 Deaf Community in Spain

The Deaf Community is endowed with an associative structure with dense networks of relationships, organized around institutions and distinctive culture. Culture in the double sense of belief systems, values, shared practices and cultural productions such as narrative, storytelling, humor, puns, sign language poetry, drama and mime, sculpture, painting, photography and films sensitive to the experiences of deaf people.

It is a living community, varied and open to all sorts of people whose central element is sign language. In Spain, the law 27/2007 of 23 October, mentions the "linguistic community of the people who use sign language Spanish (BOE, 2007).

	+6 ages	6-64 ages	64-+80 ages
Disabilities	**Total**	**Total**	**Total**
Listen	**961.489**	**295868**	**665621**
Disability to receive any sound	102.394	46952	54442
Disability for hearing loud sounds	230.736	64906	164830
Disability listening to the speech	815.639	234164	581745
Communicate	**504.813**	**244546**	**260267**
Communicating through speech	173.449	71141	102308
Communicating through alternatives language	88.642	50813	37829
Communicating through unsigned gestures	69.765	33739	36026
Communicating through writing / reading conventional	414.981	191886	223095

Figure 1: Table numbers in communicating disabilities (INE, 2010)

2. Pilot of TeleInterpretation Center

In January 2009 in Granada (Andalusia, Spain) an innovating project created by Telefónica in collaboration with the FAAS (Andalusian Federation of Associations of the Deaf) and promoted by the Andalusia local government. The target of this project was the development of a centre of teleinterpretation where the users can access telephone services through interpreters.

Deaf people find communication barriers in the access to some services of Public Administration that can be done by phone, such as:

- Request information.
- Emergency calls.
- Request an appointment.

With the target of making easy the communication between deaf people and the public entities in Andalusia, a collaboration agreement was created between different entities. As a result of this one started the LSE (Spanish Sign Language) teleinterpretation service.

2.1 The way the service works

Deaf people have a videotelephone call to the center and request the interpreter to make a call to a public entity. By this way the contact between deaf people and hearing person is established.
This flow of communication is shown in the next figure.

Figure 2: Schema Teleinterpretation Centre

2.2 Information and statistics

The pilot has been working for 1 year, with 2 interpreters and around 20 deaf users making an average of 80 calls per month.

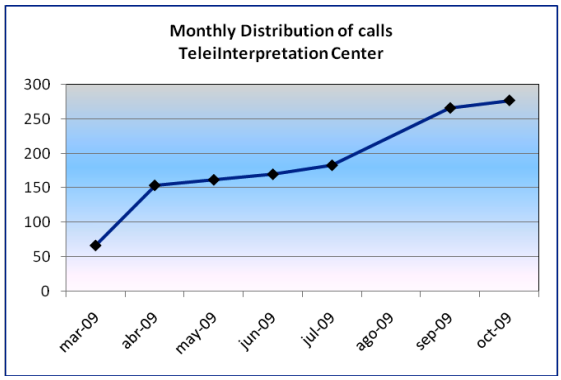

Figure 3: Statics of Teleinterpretation Centre

At first the timetable of the center was only in the morning, but because of the petitions of the users this had to be increased to morning and afternoon.

Another important feature of the pilot is that the users can make call to other deaf persons directly, without the intervention of an interpreter. So the center not only communicates deaf people with administration and other services, but it also allow users to make personals video calls between their, improving highly their communication.

One interesting fact is that the services most in demand are; asking for gas cylinders, communicating with their lawyer, the plumber…, something usual for everybody, but a complete novelty for hearing impaired users.

2.3 Results and improvements

Thanks to the experience obtained in the pilot, both, social and technological, some basic points have been defined with regards to the new development in the area of heading impaired. Here some of the next ones:

- There are not enough interpreters to attend the requirements of deaf users. Even using the platform sometimes there are users waiting.

- It is necessary develop an automatic system that can be used when the use of a interpreter is not possible.
- The system of subtitling is not a global solution. There are an important number of illiterate deaf people because of the problems with learning, and babies that are learning Sign Languages do not know how to read yet.

3. The SignSpeak Project

The SignSpeak project is one of the first EU funded projects that tackles the problem of automatic recognition and translation of continuous sign language.

The overall goal of the SignSpeak project is to develop a new vision-based technology for recognizing and translating continuous sign language (i.e. provide Video-to-Text technologies), in order to provide new e-Services to the deaf community and to improve their communication with the hearing people (Dreuw & Ney & Martinez & Crasborn & Piater & Moya & Wheatley, 2010).

The current rapid development of sign language research is partly due to advances in technology, including of course the spread of Internet, but especially the advance of computer technology enabling the use of digital video (Crasborn et al., 2007). The main research goals are related to a better scientific understanding and vision-based technological development for continuous sign language recognition and translation:

- Understanding sign language requires better linguistic knowledge
- Recognition of large vocabularies requires a more robust feature extraction methods and a modeling of the signs at a sub-word unit level
- Statistical machine translation requires large bilingual annotated corpora and a better linguistic knowledge for phrase-based modeling and alignment.

Therefore, the SignSpeak project combines innovative scientific theory and vision-based technology development by gathering novel linguistic research and the most advanced techniques in image analysis, automatic speech recognition (ASR) and statistical machine translation (SMT) within a common framework.

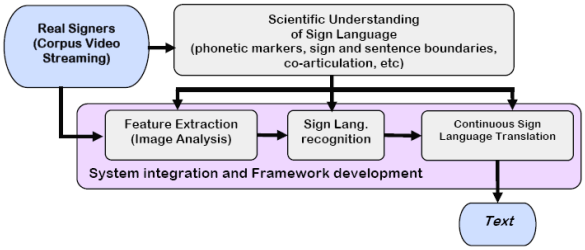

Figure 4: Conceptual scheme of SignSpeak

4. Automatic Sign Language Recognition

Nowadays one of the main problems for deaf people is the lack of interpreters. Even with system such as the platform of teleinterpretation commented on in point 2 of this paper, the number of interpreters is still insufficient for the needs of the deaf community.

One of the technologies which can propose a solution to this problem is the automatic sign language recognition (ASR), what is the conversion of a signal into a sequence of written words.

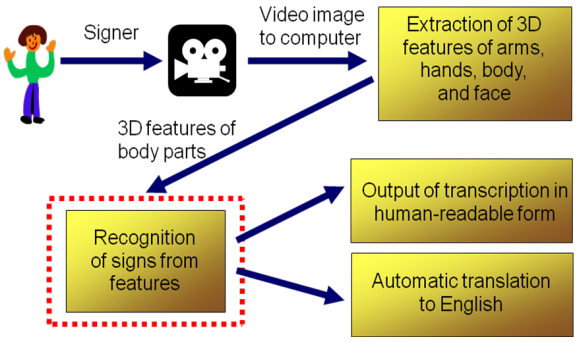

Figure 5: Schema of ASL Recognition

The ASLR would be the entrance to the system, and would allow the user communicate in real-time with a hearing person without the need for a interpreter. Another advantage to this type of application is the Internationalization, it means, the user could use the Spanish Sign Language for example, and the result of the translation could be an English text. It would be question of choose the correct parameters in the platform.

ASLR will be present in the future, and some previous problems with this technology are disappearing thanks to the advance of other researches related to this, such as gesture recognition, recognition of human actions, etc. Another reason that assures the accuracy of ASLR is the appearance of linguists in this field of investigation, and the interest of this in helping with the data translation.

In spite of the advance of the research in ASLR, this still remains a complex technique with various problems and limitations, but the target of this paper it is not to focus in the way of a system that can recognize sign language, but also to propose uses of this hypothetical futures system that improving quality of life of deaf people.

5. Future Applications based in ASLR

Once we have explained the two projects that have been served as the basis of the research about deaf community requirements, the next step is to develop the future applications that help to resolve the communication problems of hearing impaired.

These new applications will be focusing in two areas very representative of the collective, tele-interpretation and e-learning.

5.1 Teleinterpretation

Thanks to experience obtained with the teleinterpretation center pilot in Andalusia, Spain, a great number of features has been listed, that according to the users will improve the quality of this kind of service.

It is important to highlight the benefits of the teleinterpretation, which allow the user carry out tasks from home using the phone. This is a benefit for the all deaf community, because it maximizes the services that one interpreter can offer, and avoids travel time and expenses.

Even with teleinterpretation the number of

interpreters is not enough for the quantity of users, and in emergency situations is not possible to wait in a queue for your turn, so this service is one perfect candidate to make use of the ASLR.

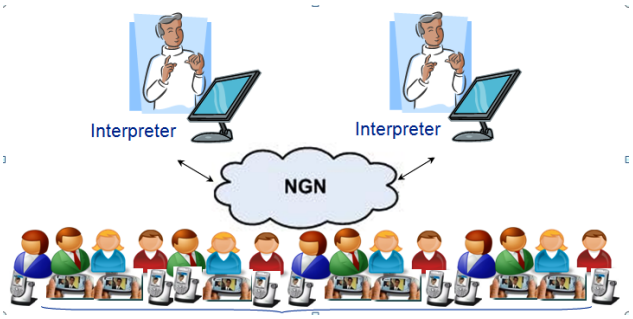

Figure 5: Too much users per interpreter

With the ASLR the users call to the center, and they can choose if they want to talk to an interpreter or talk directly with the ASLR system, in this case the application would translate, real-time the signs of the user to a text, which could be converted to an audio message by a speech tool or sent by mail or sms to the receiver.

The waiting would disappear, and the communication would be fluent and without latency. The wish of the majority of users would be fulfilled.

5.2 E-learning

The main request of the deaf associations is a system to improve the method of learning sign language.

Regarding the results and researches carried out both in teleinterpretation Center and in the SignSpeakers project; the deaf community has some great problems when teaching:

- Students have difficulties to relate concepts with signs.
- It is very uncomfortable for students, above all, for those than live in a rural area, travel to the teaching center.
- It is difficult to create a group of younger students with the same level.

The solution to all these problems is the creation of an e-learning system that give the user the possibility, of connecting from home to a learning room no matter where the lessons is being provided. The teacher explains the concepts in an e-learning center, and his signs will be translated to text and also there will be images and videos added to the explanation to make easy the understanding of the class. This process is developing in real-time, with the interaction of all the participants.

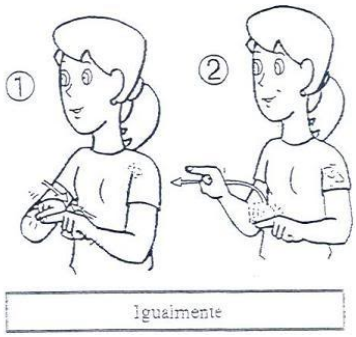

Figure 6: Learning with videos and images

6. Conclusions

Technology can improve the life of deaf people, but it is necessary to research the real need of the collective and the best way to get close the new tools to the users. Without the collaboration of the deaf groups probably this improvements would not be taken into account by the community.

In future when these technologies mature, they may help improve the independence of deaf people because in certain situations, they will not need an interpreter to accompany them.

7. Acknowledgements

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