Developing an Information System for Deaf

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Abstract

This paper presents the SAILSE Project (Sistema Avanzado de Información en Lengua de Signos Española – Spanish Sign Language Advanced Information System). This project aims to develop an interactive system for facilitating the communication between a hearing and a deaf person. The first step has been the linguistic study, including a sentence collection, its translation into LSE (Lengua de Signos Española - Spanish Sign Language), and sign generation. After this analysis, the paper describes the interactive system that integrates an avatar to represent the signs, a text to speech converter and several translation technologies. Finally, this paper presents the set up carried out with deaf people and the main conclusions extracted from it.

Index Terms: Interactive System, Translation into Sign Language, Deaf People, Hearing-Deaf People Communication, LSE, Lengua de Signos Española.

1. Introduction

In Spain, 92% of deaf people have a lot of difficulties in understanding and expressing themselves in written Spanish. The main problems are related to verb conjugations, gender/number concordances and abstract concepts. Around 47% of the Deaf, older than 10 years, do not have basic level studies (information from INE –Spanish Statistics Institute- and MEC –Ministry of Education-).

According to the information presented above, deaf people are more vulnerable and they do not have the same opportunities as hearing people. They cannot access information and communication in the same way as hearing people do: TV programs, multimedia content on the internet and personal public services. All these aspects support the need to generate new technologies in order to develop automatic translation systems for converting this information into sign language.

This paper presents SAILSE, a software application for helping deaf people to communicate with hearing people. In particular, the application domain is the reception at the CEAPAT (Centro de Referencia Estatal de Autonomía Personal y Ayudas Técnicas – State Reference Center of Personal Autonomy and Technical aids) and some of its exhibition areas.

2. State of the art

ViSiCAST and eSIGN [1] have been two of the most relevant projects about translation of speech into sign language. The ViSiCAST project was focused on producing communication tools allowing sign language communication. The eSIGN project aimed to provide sign language on websites. Another example of advanced communication systems for deaf people is VANESSA (Voice Activated Network Enabled Speech to Sign Assistant) project [2]. This project was part of eSIGN and facilitates the communication between assistants and their deaf clients in UK Council Information Centres (CIC's).

Recently two main research projects that focus on sign language recognition are DICTA-SIGN ([3]; [4]) and SIGN-SPEAK ([5] and [6]). DICTA-SIGN aims to develop the technologies necessary to make Web 2.0 interactions in sign language possible. In SIGN-SPEAK, the overall goal is to develop a new vision-based technology for recognizing and translating continuous sign language into text.

In recent years, several groups have shown interest in spoken language translation into sign languages, developing several prototypes: example-based [7], rule-based [8], grammar-based [9], full sentence [10] or statistical ([11]; SiSi system http://www-03.ibm.com/press/us/en/pressrelease/22316.wss; [12]) approaches. For LSE, it is important to remark the author experience developing speech into LSE translation systems in several domains ([8],[13],[14]). This kind of systems can complement a Sign Language into Speech translation system, allowing a two direction interaction ([15],[16]).

3. Linguistic analysis and corpus generation

The first step has been the sentence collection. For this collection, a guided visit with a deaf person was done to the CEAPAT (including its exhibition areas). This visit was recorded in videos and these videos were transcribed manually: more than 1000 sentences were obtained. The most relevant sentences were selected (428) and translated into LSE, both in glosses (words in capital letters that represent the signs) and videos. In general, deaf people prefer to use glosses instead of written Spanish because they have problems in expressing that way. Figure 1 shows the parallel corpus, with the sentences classified by exhibition areas and the links to the videos.

ÍNDICE	ÁREA	SUBÁREA	TIPO	AGENTE	CASTELLANO	LSE	VIDEO LSE
2	Recepción	Recepción	SALUDO	Técnico	hola buenos días	HOLA BUENOS DÍAS	VIDEOS\2.wmv
3	Recepción	Recepción	SALUDO	Usuario	hola buenos días	HOLA BUENOS DÍAS	VIDEOS\3.wmv
4	Recepción	Recepción	DNI	Técnico	por favor me deja el denei	DNI DEJAR-A_MI POR-FAVOR	VIDEOS\4.wmv
5	Recepción	Recepción	DNI	Usuario	tome	TOMAR-A_TI	VIDEOS\5.wmv
6	Recepción	Recepción	GRUPO	Técnico	viene en grupo	GRUPO VENIR?	VIDEOS\6.wmv
7	Recepción	Recepción	GRUPO	Usuario	no vengo solo	NO YO SOLO VENIR	VIDEOS\7.wmv
8	Recepción	Recepción	CITA	Técnico	tiene cita con alguna persona	TU PERSONA ALGUNA CITA?	VIDEOS\8.wmv
9	Recepción	Recepción	CITA	Usuario	no vengo sin cita	NO YO CITA VENIR	VIDEOS\9.wmv

Figure 1: Parallel corpus

Finally, 1,100 different signs were obtained and transcribed for the avatar representation (using glosses, SEA (Sistema de Escritura Alfabética) [18] and HamNoSys-SIGML [17]). In order to facilitate this task a sign editor (Figure 2) has been used. Figure 3 shows the sign database, where each sign

is represented by a gloss, SEA and Hamnosys notation and a link to the SIGML file.

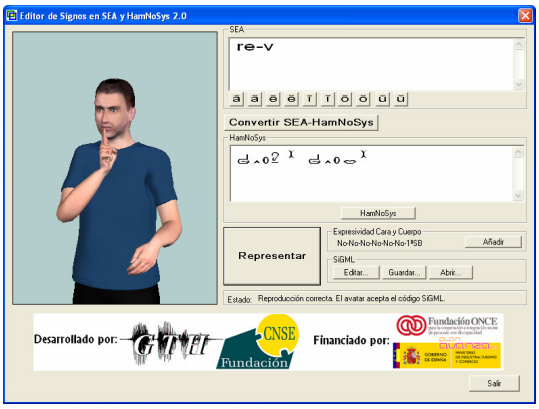

Figure 2: SEA-HamNoSys-SIGML sign editor

GLOSA	SEA	HAMNOSYS	SIGML
ABRIR	ABRIR		SIGMLVABRIR.txt
ACCESIBILIDAD	sòaméuhu òmèwei		SIGMLVACCESIBILIDAD.txt
ACCESIBLE	sòaméuhu òmèwei		SIGMLVACCESIBLE.txt
ACCESO	sòaméuhu òmèwei		SIGMLVACCESO.txt
ACCIDENTE	s ebomillic		SIGMLVACCIDENTE.txt
ACOMPAÑAR-A_MI	saca íájwe-ye		SIGMLVACOMPAÑAR-A_MI.txt
ADAPTACIÓN	sl omadaheldc		SIGMLVADAPTACIÓN.txt
ADAPTAR	sl omadaheldc		SIGMLVADAPTAR.txt
AGUA	v.amapob		SIGMLVAGUA.txt
ALARMA-SONIDO	r.eumaucr		SIGMLVALARMA.txt
ALGUNA	sch.ðazpeb		SIGMLVALGO.txt
ALTO	òameawa		SIGMLVALTA.txt
ALTURA	ALTURA		SIGMLVALTURA.txt

Figure 3: Sign database

4. Interactive System

Several technologies has been integrated in the SAILSE application: a visual interface developed under Visual Studio, an avatar to represent the signs, a text to speech converter and a language translation module for converting a sign sequence into a Spanish word sequence. With this translation module, a deaf person can ask questions in a free style (considering this restricted domain).

4.1. Visual interface

The visual interface has different scenarios or possible situations. The first one is the "BIENVENIDA" (welcome) scenario (Figure 4). In this scenario, there are three possibilities: it is possible to visit directly the exhibition pressing the button "IR EXPOSICIÓN", to go to the "RECEPCIÓN" (reception) scenario to interact with the reception employees or to go to the "DESPEDIDA" (goodbye) scenario before leaving the exhibition.

Figure 4: "Welcome" scenario

There are auxiliary buttons presented in all the scenarios at the bottom. These buttons are: general information of the CEAPAT (WC, café, library, etc.), help button (AYUDA), exit of the application (SALIR), to return to previous scenario (VOLVER), to visit the exhibition (EXPOSICIÓN), to go to the welcome scenario (INICIO), to repeat (REPETIR) or to stop (PARAR) the representation of the signs or the speech. And also the button "ENFERMO" (feel bad) and "TEXTO" (text) that will be explained later.

In the reception scenario (Figure 5) deaf users and the reception employees can communicate each other. For instance, the employee can ask user if he/she has an appointment with some CEAPAT technical employee. There are several frequent questions that the employee can ask and the system translates into LSE (For instance, "Por favor, ¿me deja el DNI?" ("Could you give me your ID card, please?")). And also the user can form sentences into LSE (with the "TEXTO" scenario) and the system translates them into speech.

Figure 5: "Reception" scenario

Figure 6: "Exhibition" scenario

There are three different areas in the exhibition (Figure 6). And there are different sub-areas in each area. The user can select each sub-area for obtaining the corresponding information signed by the avatar on the left and also a summarized text with the information. You can also select a particular line of the information and the avatar would sign only this particular information (Figure 7).

Figure 7: Information about a particular sub-area of the exhibition (signed by the avatar and summarized text)

The user has also the possibility of composing sentences with glosses in Spanish Sign Language (Figure 8). This is the best option because deaf people have a lot of difficulties in expressing themselves in written Spanish. There is a keyboard (with two possible configurations: alphabetical order and QWERTY) with all letters and number and an image of its signed representation (similar to a mobile phone). The user can write sentences with glosses and the system translates them into speech by pressing the "VOZ" (voice) button.

Figure 8: Scenario for forming sentences in LSE

Figure 9: Scenario for emergency situations

There are other two scenarios: "ENFERMO" (feel bad), where the deaf user can ask for help if he feels bad (for instance, if he needs a chair to sit down) (Figure 9), and "DESPEDIDA" (goodbye), where the user can ask for information about taxis, metro, restaurant or documentation about the exhibition.

4.2. Sign representation

For the sign representation, the VGuido avatar has been used: the eSIGN 3D avatar developed in the eSIGN project (http://www.sign-lang.uni-hamburg.de/esign/). [1]

4.3. Text to speech conversion

For the text to speech conversion, the system incorporates the Spanish female voice of the CereProc enterprise (http://www.cereproc.com/es). The interaction with the voice synthesizer is carried out with the Microsoft SAPI (Speech Application Programming Interface).

4.4. Language Translation

The translation module has a hierarchical structure divided into two main steps. In the first step, an example-based strategy is used to translate the word sequence in order to look for the best possible match. If the distance with the closest example is lower than a threshold (Distance Threshold), the translation output is the same as the example translation. But if the distance is higher, a background module based on a statistical strategy translates the word sequence. During the developing tests, the best results were obtained for a Distance Threshold (DT) ranging from between 20% and 30%. In the field set up, the DT was fixed at 30% (one difference is permitted in a 4-word sentence).

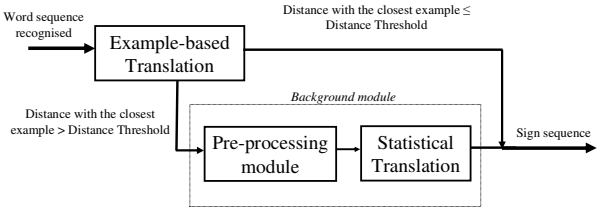

Figure 10. Diagram of natural language translation module combining two different translation strategies

The statistical translation strategy incorporates a pre-processing module that permits to increase its performance [19]. The statistical translation module is based on Moses, an open-source phrase-based translation system released from NAACL Workshops on Statistical Machine Translation (http://www.statmt.org) in 2011.

5. Set up with deaf users

A set up with deaf users has been performed for testing the communication system with deaf users in a real scenario (Figure 11).

Figure 11: Different photos during the set up

The set up was carried out over two days, involving 4 deaf people (1 female and 3 male), two people per day. They had to sign a consent form in order to take photographs. The user ages ranged between 31 and 60 years (42 average) who interact with one of the developers of the system, who had the role of CEAPAT employee. Three users said that they used a

computer very often (they usually have experience with video edition programs with a minimum written Spanish), and only one of them had less experience with computers. Three of them had a high understanding of written Spanish (one of them had low understanding) and only one of them had a high glosses understanding.

Four different scenarios were defined in order to simulate real situations. In three of the four scenarios, users had to simulate that she/he looked for particular information in the tablet. And after that, several questions about the provided information were asked to the user in order to evaluate his/her compression of the given information. In the fourth scenario, the user should ask several questions to the CEAPAT employee by using the "text" toolkit of the system in order to measure the usability of that toolkit.

Regarding to the first part of the set up (users must understand the information the system gives), results show that three of four users understand the given information in a first attempt and one of them in the second one. A third attempt usually is not necessary. In respect to the second part (users must compose sentences in glosses with the text toolkit), they needed several attempts for forming the first sentence (even with an easy sentence), but quickly they learn the behavior of the toolkit and are able to form a much more complicated sentence at the first attempt.

Finally, in general, it is possible to conclude that the higher understanding of written Spanish helps to a more efficient use of the system. And there is also a relation between the younger age of the user and his agility using the toolkit.

6. Conclusions

This paper has presented the interactive system developed in the SAILSE project for facilitating the communication between a hearing and a deaf person. The paper has explained the linguistic study carried out and the system development. This system integrates an avatar to represent the signs, a text to speech converter and several translation technologies.

Finally, this paper presents the set up carried out with deaf people and the main conclusions extracted from it. Results show that system helps to a better understanding of the information presented in the exhibition of the CEAPAT by deaf people. The higher understanding of written Spanish helps to a more efficient use of the system. And there is also a relation between the younger age of the user and his agility using the toolkit.

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