

Chapter 5.

REPRESENTATION OF THE SIGNS

This chapter discusses the aspects concerning the representation of signs: animate agent, notation used to describe the signs, database generated, and so on.

After a general introduction to the system of representation and a tutorial to install the application and required elements, we proceed to describe HamNoSys notation system used for the transcription of the signs as well as the publisher ESIGN used for the generation of signs. It also describes the database created and the limitations of the editor.

Finally, it describes the program used to display the representation of signs by VGuido animate agent.

1 INTRODUCTION

1.1 INTRODUCTION

For the representation of signs has used a 3D animated virtual agent, the avatar "virtual Guido" (VGuido) developed by Televirtual Ltd. in the project Sign (*Essential Sign Language Information on Government Networks*)¹. An avatar animation generated by a temporal succession of images, each of which represents a static posture of the avatar, which in turn is defined by specifying the configuration of the skeleton of the animated agent.



Virtual Agent VGuido

In ViSiCAST project (*"Virtual Signing: Capture, Animation, Storage and Transmission"*), predecessor of eSign, the signs were originally generated by motion capture. This technique is that a sign language expert, equipped with a system to capture their movements, representing the signs one by one. These are recorded in a file, thereby allowing animate virtual agents directly. However, this technique has serious drawbacks. First, the equipment is very expensive, and therefore not easily dispose of it, so that once a sign is stored, it is not easy to change, unable to adapt case of linguistic variation. Moreover, the configuration and calibration of equipment for each session are difficult tasks to perform and time-consuming. Finally, the team is awkward to carry, and it is not able to detect small movements, so many signs need to be modified after capture [1].

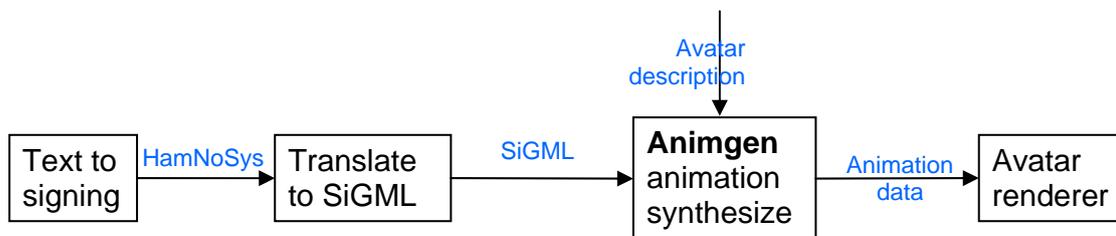
It is for these reasons that VGuido not use motion capture, but the animation is generated from descriptions of the signs through HamNoSys (*Hamburg Notation System* - "Hamburg Notation System"), a system of notation for Language Signs, regardless of the avatar [2]. By HamNoSys defined aspects of hand position, speed signs, the amplitude of gesture, and so on.

HamNoSys focuses on the manual part of signs. However, the implementation of the non-manual (nods, eyes, mouth, etc..) Is also fundamental in sign language. ESign Editor tool, designed in the project eSign provides an editing environment that

transcribes the signs of a quick and easy, also incorporating the tools needed to describe the non-manual signs.

Since computers can not process the syntax of these descriptions HamNoSys, University West Anglian was designed SiGML ("*Signing Gesture Markup Language*" - "*Marking of gesture Sign Language*), a modified version of XML², and generated a translator of HamNoSys to SiGML. The description of a sign SiGML contains exactly the same information as the description HamNoSys, but in a language that computers can process. This information is processed in a synthesizer, which, taking into account the description of the geometry of the animated agent, complete all details SiGML transcription may have omitted, as the default location of the avatar, the duration in seconds of each movement (SiGML expressed simply as fast speed, slow or normal, etc.), resulting in a more detailed transcript SiGML, SiGML Extended, which can describe some details that can be implemented with HamNoSys.

Finally, this description of the signs is represented by virtual animated agent. In [Figure 2](#) shows the block diagram of the process used to generate an animation of a sign.



Block diagram of the generation of an animated sign

The sophisticated motion models allow employees to have a good quality of representation in terms of recognition of signs, next to the quality of representation generated from motion capture. The main advantage of this technique is its flexibility, since the generation of the vocabulary of signs does not require any special equipment, and the description of the signs are simply stored in a database. This can form quickly phrases in sign language, selecting the glyphs needed for the database and linked in the appropriate order.

1.2 TUTORIAL. ESIGN EDITOR AND INSTALLING VGUIDO

Creating and animated representation of signs is necessary to install the corresponding software: Editor eSign software and animation software, which contains information on the geometry of the avatar. VGuido animated agent and animation modules have been incorporated into the system as an ActiveX control.

1.2.1 Tutorial. VGuido Installation

To install the avatar VGuido and view correctly, the system must meet the following requirements [4]:

- Processor: Intel Pentium Windows
- Operating System: Microsoft Windows 2000 with Service Pack 2, or Windows XP Professional or Home Edition.
- Memory: 128 MB of RAM. 30 MB of available disk space.
- Graphics Card: nVidia GeForce4 or equivalent quality.
- Browser: Internet Explorer 6.
- Java: Java Environment (JRE, *Java Runtime Environment*) 1.4 or higher. The installation program automatically checks for the JRE already installed on your PC.

Currently, the avatar is only available for Windows, there is no facility available for Macs or for browsers other than Internet Explorer.

VGuido The avatar can be freely downloaded for personal use from the website of eSign, <http://www.sign-lang.uni-hamburg.de/eSIGN/Software.html> in eSign Avatar Plugin Installer package. This software lets you view VGuido animated agent on those websites that incorporate the avatar.

However, if one wants to incorporate the animated agent in a Windows application, as is the case with this project, you must install the ActiveX control version 2.6.7 Signing SiGML. This ActiveX control is incompatible with the previous plugin, so for the proper functioning of ActiveX control must be uninstalled prior Plugin. SiGML By installing 2.6.7 Signing installed a number of applications for the representation of signs with the avatar, a series of examples and a set of components, among which include the SiGMLSigning.dll. This is the main component of the package, and uses other components installed to provide the functionality needed by applications signed. Allows to convert SiGML animation. After installation of the package will be generated SiGMLSigning folder in C: \ Program Files \ eSign.

The software includes all the relevant information about the characteristics of the avatar:

- The positions of the joints of the animated agent.
- Information about minutiae that can be described with HamNoSys system as "the center of the forehead," the tip of the chin ", etc..
- Each joint type: if it works like a hinge, if it fits one part to another, and so on.

- Information on aspects of body language generation speed signs, how fast are the stops if a hand is moved to a certain point, the typical time it takes a hand in moving from one position to another, and so on.

For a more detailed description of applications and components can be consulted ReadMe installed software.

1.2.2 Tutorial. ESign Installing Editor

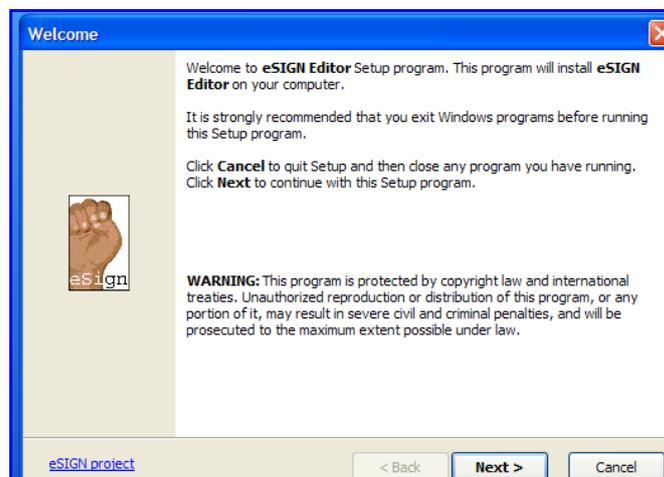
ESign editor allows users to create new signs, which can be represented by VGuido.

This tool was developed for Windows 32 bit platforms and MacOS, in three languages user interface (English, German and Netherlands). Since working with Unicode internally, does not support older versions of operating systems (Windows 95, Windows 98, Windows ME and MacOS 9). In the future, might become available a Linux version, if any of the partners eSign request [3].

ESign editor has been implemented using RealBasic ³. In this environment can be defined two databases, so that you can replace one of the databases RealDatabase set by default with MySQL databases, Frontbase, Postgresql, or anything else that supports ODBC (including FileMaker and MS SQL).

To install the editor eSign should follow the steps below.

1. Copy the source hamno33, HamNoSys corresponding notation in the folder WINDOWS / Fonts. ESign By editor the user can generate using the notation signs HamNoSys, so that should add to the character system used in this notation.
2. Editor eSign Install software by following the directions provided in the Setup program (Figure 3). After installation is generated eSignEditor folder in C: \ Program Files \ eSign. This folder contains the report "*Deliverable 2.3: Intelligent Sign Editor*" [3], which provides the information needed to successfully use the editor and generate the description of the signs.



Setup Window eSign Editor

3. You can install additional modules to support specific features of certain signs, such as counting or spelling.

Once installed, the editor can be accessed through the Start menu or using the shortcut icon shown with the [Figure 4](#).



Direct access to eSign Editor

1.3 HAMNOSYS SYSTEM

The Hamburg Notation System (HamNoSys, "*Hamburg Notation System*") is a phonetic transcription system for sign language, which includes more than 200 symbols. It was developed in the 1980s at the Institute of German Sign Language at the University of Hamburg, for transcription of signs both individual and phrases in sign language [\[6\]](#).

So far, HamNoSys has been used as a reference notation in several research projects in Sign Language. However, in the context of generation signs ViSiCAST is the first project that has been used to store HamNoSys in the vocabulary of phonetic transcription of individual signs, and then combine them into sentences. By implementing ViSiCAST HamNoSys was decided to use for several reasons. First, the notation system is more stable and more frequently used among the community of sign language. It is also a language-independent system, ie can be applied indiscriminately to all sign languages. Finally, the notations are compact and easy to introduce in an editing environment of signs.

HamNoSys has been designed following the basic principles described below [\[2\]](#):

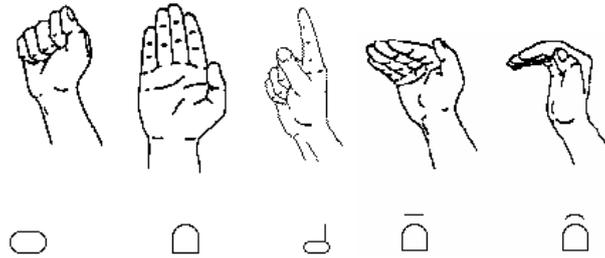
- **Language independence.** HamNoSys is not specific to a particular Sign Language, it allows to describe any signs of any language. This feature stems from the original motivation that led to the implementation of HamNoSys: written to provide a means for researchers to describe signs.
- **Description of posture and movement, not of meaning.** The meaning of a sign is described in HamNoSys not only describes the position and movement of hands. A sign may have different meanings in different contexts, but if it is in the same way, HamNoSys transcription is the same.
- **The omission of irrelevant information.** Only describe the parts of posture and movement that are important in creating a sign. Most signs are represented through the hands and face, so that the position of, for example, shoulders and elbows is not important, just have to adapt naturally to the hand position. Thus, shoulders and elbows have no notation in most of the signs.

HamNoSys allows to describe the signs in terms of form, orientation, position and movement of hands. Each of these aspects is described below in the following paragraphs.

1.3.1 Hand shape

In HamNoSys system defines 12 standard forms of the hand open hand, closed hand, C-shaped hand, index finger extended, two fingers extended (together or separately, etc.).

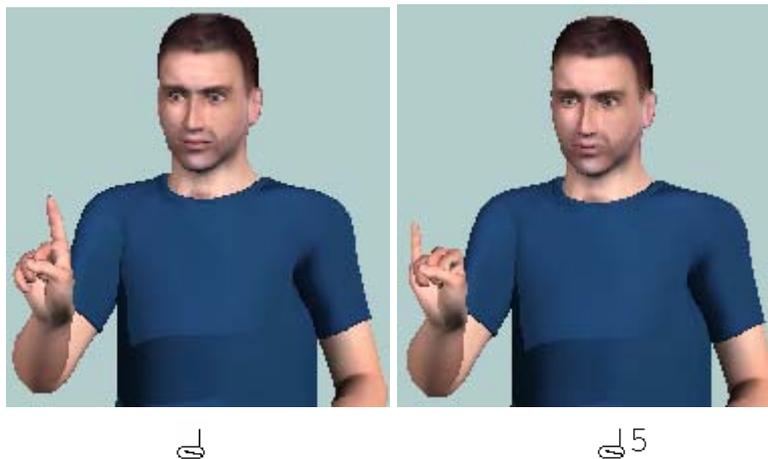
On these forms you can apply a patch set, changing the inclination of the fingers or thumb position. Below are some examples.



Transcript HamNoSys for some forms of the hand [5]

The figure shows the representation for different forms HamNoSys basic hand and some of the changes of the inclination of the fingers that can be performed.

In each case, the fingers may indicate referred to the transcript. For example, the symbol ‘ \cup ’ refers to the default form of the closed hand with index finger extended. However, transcription may indicate that the finger has to be extended by simply adding the appropriate symbol (number of 1 to 5) below, as shown in the following VGuido representation, where the finger is extended pinky.



Transcript HamNoSys for the shape of the hand with little finger extended

The system also allows alerts to cross their fingers, or hide the thumb between two fingers determined. For example, by expressing ${}^2 \hat{\square}^3$, cross the third finger on his forefinger.

Additionally, you can transcribe intermediate forms between any two of those defined by the symbol between two symbols \ HamNoSys. The figure below shows an example of this situation.



□

$\hat{\square}$

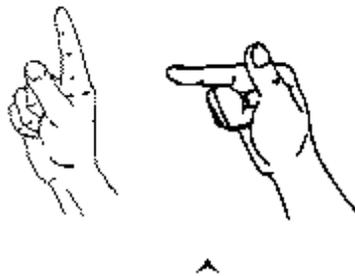
□ $\hat{\square}$

Transcript HamNoSys for two forms of hand and middle position

1.3.2 Hand Orientation

The three-dimensional orientation information of the hand is divided into two parameters: the direction of the base of the forefinger and the orientation of the palm. The first defines the direction of the axis of the hand, while the second defines the orientation of the hand along the axis.

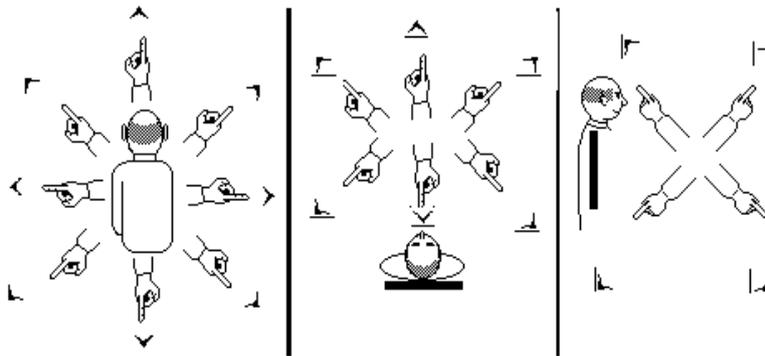
The *extended finger direction (EFD)* is the direction that would be pointing the finger if it were extended. Has 26 possible values, which correspond to addresses can be drawn from the center of a cube to the centers of their faces, the midpoints of its edges and vertices.



Transcript HamNoSys for upward facing direction [5]

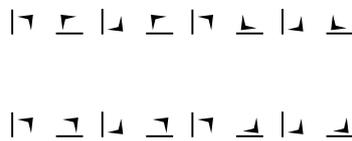
The figure shows an example of direction of the axis of the hand, with your transcript HamNoSys. Both representations have the same direction from the base of the index finger, changing only the inclination of the finger.

In the [Figure 9](#) shows some of the possible directions of the axis of the hand, with transcripts in HamNoSys.



Transcript HamNoSys some possible directions of the base of the index finger [5]

In addition to those indicated in the figure, we can define eight intermediate directions between them, introducing a symbol of direction of the base of the index finger after another, as follows:



The **orientation of the palm** can take eight different values, each indicating an orientation of the palm around the shaft of the hand. That is, if for example the direction of the base of the index finger is forward, the palm can be up, down, right, left, or to any of four orientations intermediate between them.

Below are some examples of the direction of the axis of the hand and palm orientation as this axis.

△○: Address of the axis of the hand forward, palm down.

^○: Direction of the axis of the hand up, palm forward.

^0: Direction of the axis of the hand up, palm to the left.

(The dark part of HamNoSys symbol always represents the palms.)

In some signs, the orientation of the hand varies constantly during a drag (eg in wave motions), maintaining a constant relationship with him. To transcribe this symbol is used (\sim), Which is introduced below the symbol of guidance.

For both the direction of the base of the index finger to the orientation of the palm can be transcribed intermediate directions between any two of those defined by the symbol between two symbols \ HamNoSys. For example, in the following figure shows the direction midway between the left horizontal and vertical upward. The result is equivalent to that obtained by directly enter a symbol HamNoSys ($\langle \wedge$).



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^

<\^

Transcript HamNoSys for two directions of the axis of the hand and middle

1.3.3 Location of hand

The hand can be placed in different parts of the body, and at different distances: in contact with the body (x), close ($^{j^c}$) at a normal distance (default) or away from the body ($^{\rightsquigarrow}$). There are dozens of symbols in HamNoSys to transcribe the location of the hand: head (o), shoulders ($^{\square}$), chest ($^{\equiv}$), nose (†), chin ($^{\smile}$), palm contrary ($^{\sim}$), etc.. , and the hand can be placed to the right, left, or center of each of these body parts. The following table lists some of the most frequently used locations.

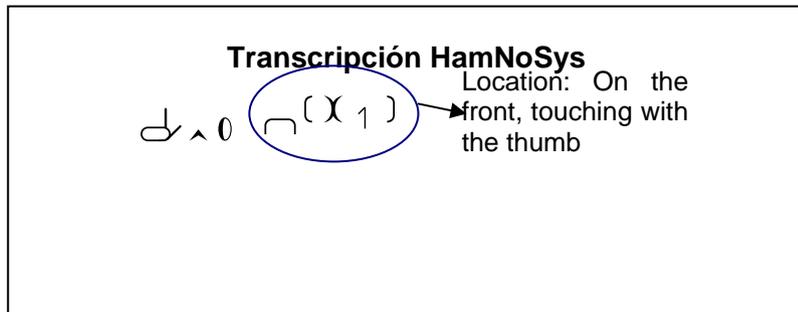
	Left	On the left	Center	On the right side	Right
Head	□ ○	■ ○	○	○ ■	○ □
Front	□ ∩	■ ∩	∩	∩ ■	∩ □
Nose	□ ∩	■ ∩	∩	∩ ■	∩ □
Mouth	□ ∩	■ ∩	∩	∩ ■	∩ □
Chin	□ ∩	■ ∩	∩	∩ ■	∩ □
Neck	□ ∩∩	■ ∩∩	∩∩	∩∩ ■	∩∩ □
Shoulder line	□ ∩	■ ∩	∩	∩ ■	∩ □
Breast Line	□ ∩	■ ∩	∩	∩ ■	∩ □
Stomach Line	□ ∩	■ ∩	∩	∩ ■	∩ □

Example of some of the locations most frequently used

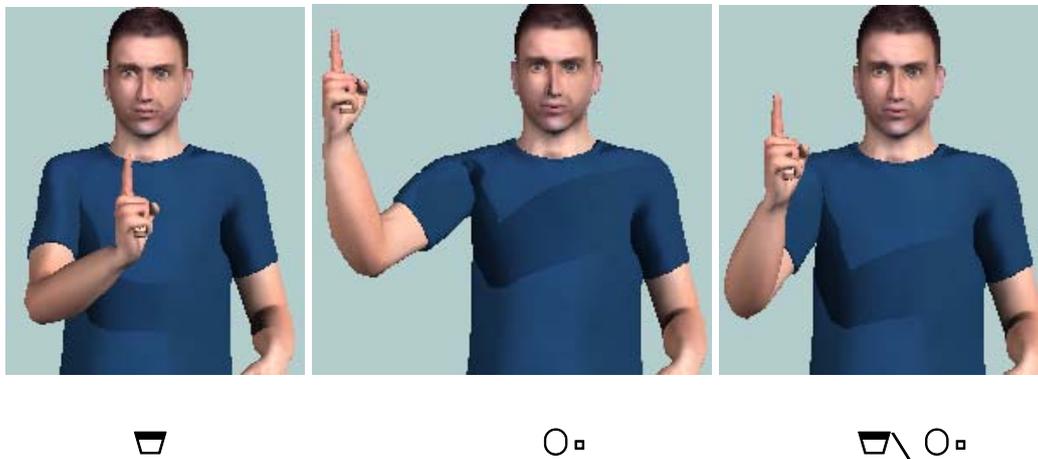
When there is contact between the hand and a body part can be bracketed to indicate what exactly part of the hand contact is made (fingertip, palm / back of the hand, right side / left finger, etc.). The following example shows the representation for the sign VGuido GERMANY ", and HamNoSys transcription, indicating that it should touch the forehead with the thumb.



Representation by the sign VGuido GERMANY "and transcription HamNoSys



You may transcribe any intermediate position between two defined either by the symbol between two symbols (\setminus) HamNoSys. In [Figure 12](#) shows an example of this situation, which gives the position between the location of the hand to chest height and location of the right hand of the head.



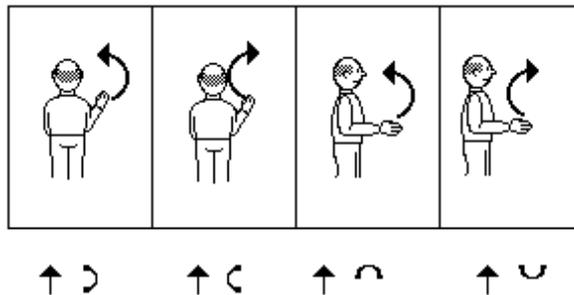
Transcription HamNoSys for two locations and their intermediate position

1.3.4 Hand Movements

The description of the movements can become quite complex. Can be defined hand movements in space, or hand movements without changing their location (eg, finger flexion).

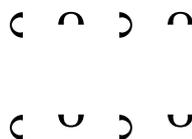
Movements that can perform the hand through space can be:

- **Straight.** The description of movements in a straight line follows the same principles that the description of the direction of the base of the forefinger, so that movements can be performed in the 26 different directions outlined above for the axis of the hand. For example, the transcription HamNoSys for a movement in a straight line corresponds to (\uparrow) upward, and forward (\uparrow).
- **Curved.** After indicating the direction of movement through symbolic description of motion in a straight line, she shoves one of the symbols of curved movement, where the plane of the curve can be oriented in 8 different ways, similar to the various possible orientations of the palm. For example, an upward movement can make a curve to the right, left, outward and inward, as shown in [Figure 13](#).



Transcript HamNoSys some examples of curved movement [5]

In addition you can define four intermediate between these movements by introducing a curved movement symbol after another, as shown below:



- **Circular.** You can define three levels of representation of circular motion: horizontal (\curvearrowright , \curvearrowleft), vertical in the plane parallel to the person (\curvearrowright , \curvearrowleft), and vertical in the plane perpendicular to the person (\curvearrowright , \curvearrowleft). Furthermore, we can define the intermediate planes between them. For each of the circular movements described can define a direction of rotation or the opposite. You can also set the point of the circle in which movement begins and the point

where it ends, using the following symbols: (\odot \circ \ominus \oslash \oplus \ominus \oplus \ominus \oplus \ominus \oplus). Below are some examples of using these symbols.

Example

(\odot): Circular motion in the direction of clockwise, starting and ending at the top.

($\odot\circ\ominus$): Movement of three quarters in circumference in the direction of clockwise, starting at the top.

($\odot\oplus\ominus$): Movement of seven quarters in circumference in the direction of clockwise, starting at the top.

Ellipses can be described well by introducing the corresponding symbols (\ominus , \oslash , \oplus , \ominus) after the symbol of circular motion. For example the expression ($\odot\ominus$) correspond to an ellipse displayed in front of the body, wider than high.

- **Aimed at a particular location.** (\rightarrow) By the symbol is possible to change the location of the hand, placing it in the place of interest.

It is also possible to define one of three types of movements described above, then add HamNoSys transcription of the location where the movement should end.

For each of these movements (except that the movement is directed to a particular location and used the symbol (\rightarrow)), it is possible to define a zigzag movement or wave motion (\sim , \sim). Also you can set the length of motion in a straight line or curve, and the size of the diameter of circular motion. Specifically, a short stroke or small diameter is indicated by the symbol (\circ), long stroke and a large diameter or by the symbol (\bullet). Finally, it may also indicate whether the movement is fast, slow, if it ends abruptly, and so on.

You can repeat a movement, a (\oplus) or repeatedly ($\oplus\oplus$) and counter-clockwise motion made (\ominus) or in the same direction. Furthermore, it may indicate that the repetitions of the movements are declining or increasing in amplitude, or start at a point in ending the previous or returning to point of origin. For example, the

expression ($\downarrow \uparrow \supseteq$) generates a downward motion that is repeated several times, each time with a smaller amplitude. Similarly, the expression ($\downarrow \uparrow \supseteq$) also generates several downward movements increasingly less extensively, but in this case each movement begins at the point where the previous ended.

As for the *hand movements without changing the placement*, they may refer to:

- **Changes in the shape or orientation of the hand.** The change in shape or orientation of the hand (either from the direction of the base of the index finger or the orientation of the palm), is indicated by the symbol (\curvearrowright), introducing the left side of the arrow shape/original orientation, and on the right side of the form/final orientation.
- **Movement of your wrist.** The doll can repeatedly move vertically (up - down) by the symbol (\updownarrow), and horizontal (right - left) by the symbol ($\left\leftrightarrow$). And it supports rotation movements.
- **Movement of fingers.** (\palm) By the symbol can describe a finger movement called "fingerplay" (set of fingers).

All movements described may be combined sequentially or in parallel. Is, you can make a move after another, simply by typing in the corresponding order HamNoSys symbols of the movements that wish to pursue, or repeat a movement while doing another. Below are some examples of the latter situation. Importantly, the use of parentheses and symbols ($\left(\right)$) repetition to successfully deploy these movements.

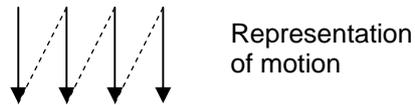
Example. Wrist movement during a linear or circular motion.

($\curvearrowright \updownarrow \uparrow$): continuous rotation of the wrist to the right while drawing a circle in space.

More examples on the following page...

Example. Repetition of a movement as the hand moves.

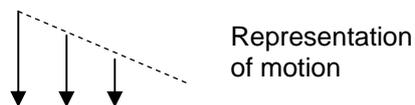
$(\downarrow (\uparrow \rightarrow))$: downward movement is repeated several times while the hand moves to the right.



$(\downarrow (\uparrow \rightarrow \simeq))$: downward movement is repeated several times while the hand moves to the right, having increasingly less separation between each repetition of the movement.



$(\downarrow (\uparrow \rightarrow) \simeq)$: downward movement is repeated several times, to a lesser extent each time, while the hand moves to the right.



Representation of signs with both hands

1.3.5 Representation of signs with both hands

In the same way they have defined the parameters for a single hand, dominant hand, can be defined for the non-dominant hand. The two hands can be the same or different shape, orientation, location, and movement, and these parameters can be symmetrical about the horizontal axis (⋮) or about the vertical axis (⋈). In addition, we may define the distance between the two hands, describing if they are in contact (X), close (⌋), far (↔) or a normal distance. It is worth noting the difference in the interpretation of transcription depending on whether HamNoSys away these symbols are found before or after a location symbol. This may be explained easily by the following example. In a description HamNoSys with two hands, the expression indicates that (X □) hands are at chest height, at a normal distance of the body and in contact with each other. However, the expression indicates that (□ X) hands are in contact with the body at chest height, and make no contact between them.

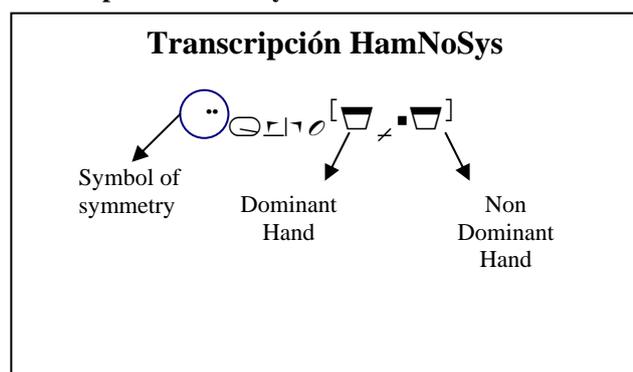
If both hands have the same shape, orientation and location, and move in the same way, to transcribe the sign is enough to put the symbol of symmetry, then the description of the sign as if for a single hand. In this case, the hands are placed near each other, so that if they are to be removed, it should be noted, describing the location for each hand. If, however, some of the parameters between the two hands is different, the transcription HamNoSys has the following structure:

Symbol Parameters communes symmetry between the two hands
[Parameters Parameters ≠ dominant hand non-dominant hand]

The figure below shows the sign "authority", which uses two hands, with his HamNoSys transcription.



Representation of the sign "AUTHORITY" and transcription HamNoSys



For more information about the system HamNoSys can consult the website of the University of Hamburg:

<http://www.sign-lang.uni-hamburg.de/Projekte/HamNoSys>

and the document "*Deliverable D5.1: Interface Definitions*", which can be downloaded from the website of ViSiCAST:

http://www.visicast.cmp.uea.ac.uk/Papers/ViSiCAST_D5-1v017rev2.pdf

1.4 EDITOR ESIGN

1.4.1 Description of Editor ESIGN

ESIGN editor is a tool designed to let users create signs easily. These signs can be represented by an animated agent ESIGN.



ESIGN Editor Interface

ESIGN A document editor is composed of a series of descriptions of signs. The editor window is structured in two columns, in order to allow parallel represent an expression in natural language and its translation into sign language. In the left column you enter a phrase, which can be a word or phrase, while the right is introduced for description of the sign translation. The document is divided into rows, each containing the description for a sign or phrase marked. At the top of the window displays several buttons:

- **Button +.** Lets you add a new description marked.
- **- Button** Delete the selected sign.
- **Join button.** Lets unite two rows into one, leaving the signs described in the second then those described in the first. To divide a line into two, just place the cursor in the column on the left between the words corresponding to the signs they want to divide, and press the Enter key.

- **Button animation.** Theoretically, it allows the representation by the sign described VGuido. However, when installing the application and press this button, an error occurs, so to represent the signs had to develop a test program that will be described later.

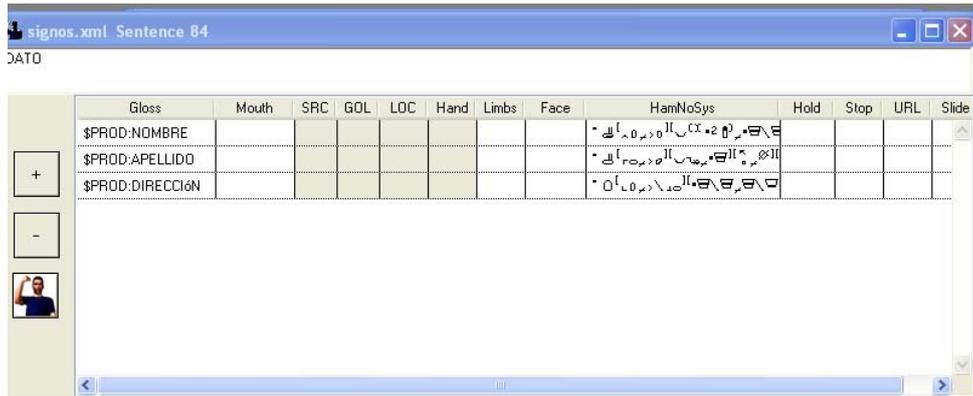
On the other hand, if you click on this button while holding down the **Alt** key, the file is generated. SiGML selected for the sign ([Figure 16](#)).



File generation. SiGML

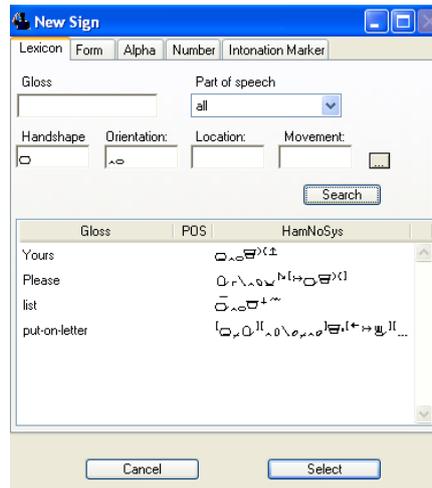
When creating a new sign or phrase marked, a new row is added to the document. Each sign must be generated separately, so that each row can be displayed a window by double clicking on the column to the right, which defines sequentially signs that make up sign language sentence. In this window you can define each sign and various parameters, such as movement of the mouth, head, eyes, etc., The user can configure where the boxes are not gray.

In [Figure 17](#) shows an example for the translation of "fact" that generates the signs "NAME", "LAST" and "direction". For each of them can be defined HamNoSys transcription, and other features that are described later.



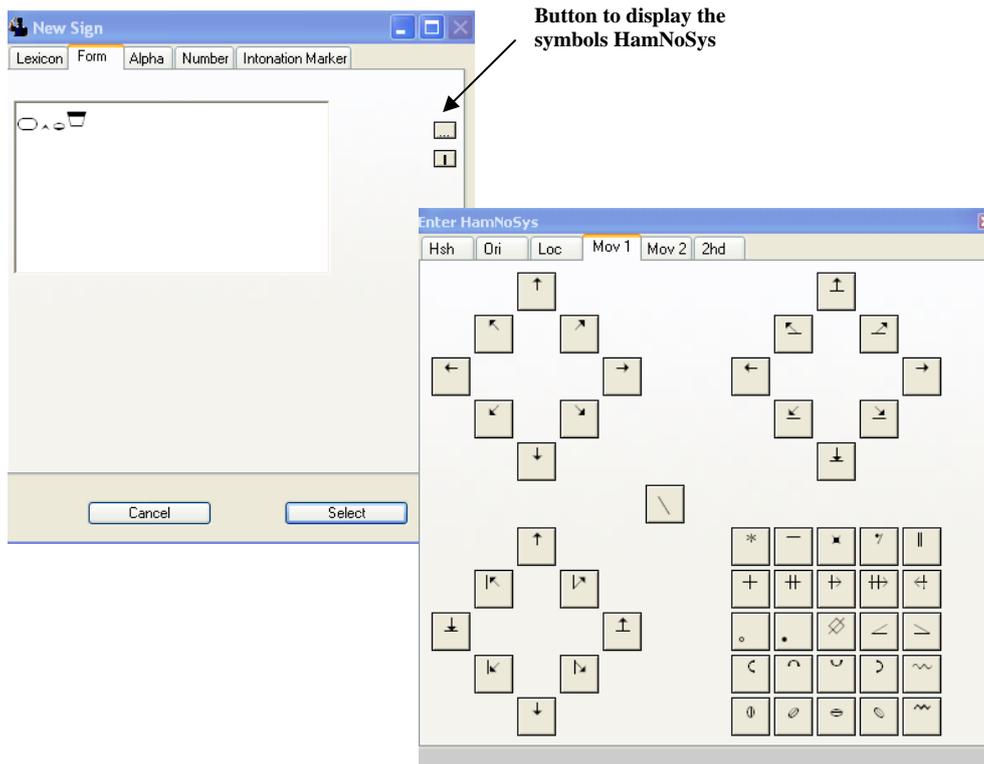
Window to define new signs

Each of the signs can be described completely from the beginning, or generated from another by changing a sign contained in the vocabulary. You can enter search criteria, indicating the shape, orientation, location, or name of the sign, which will only show the signs of the vocabulary they have certain characteristics (Figure 18).



Search for signs in the vocabulary

If a sign is not in the vocabulary can be described by HamNoSys, which is accessed through the tab "Form" (Figure 19). The names of the signs described in this way are preceded by the phrase "\$ PROD:".



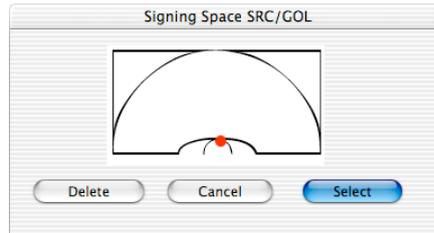
Window description HamNoSys

By the tabs "Alpha" and "Number" you can add spelling and number sign representation, respectively. The signs described by spelling are preceded by the phrase "\$ ALPHA", and the numbers are preceded by the phrase "\$ NUM"

The window "Intonation Marker (Bookmark pitch)" allows entering expressions signs that do not provide information about the topic of interest, but allowing the discourse structure, with elements like "end ", "change the subject ", etc.. The list of these markers can be modified with the editor itself ESIGN.

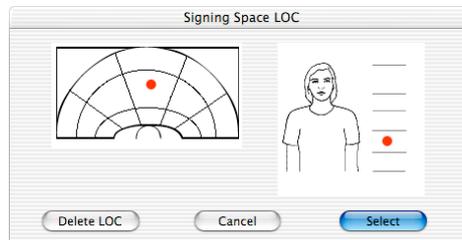
ESIGN editor allows to describe a sign or make changes on it in a simpler way, without introducing HamNoSys symbols manually. This will use the windows source (SRC, "Source"), destination (GOL, "Goal"), location (LOC, "Location"), and classification of the shape of the hand ("Hand"). They are accessed by double clicking on the corresponding cell, provided it is blank, in which case the sign you wish to change the vocabulary is labeled to allow for these changes. If the cell is gray, it is recommended not to make any changes.

The SRC and GOL windows allow the mouse to select the person (first, second or third) that addresses the animated agent, specifying the position they should occupy their hands in the space marked.



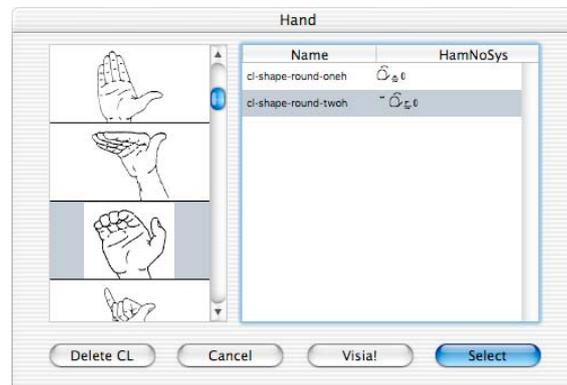
Windows SRC / GOL

The LOC window lets you specify a hand position in both the horizontal and vertical, with the mouse selecting a particular point in space. The location of the selected point is close to the location closest transcription HamNoSys possible.



Window LOC

The window *"Hand"* shows a series of hand shapes in a column on the left. Selecting one of them is a list to the right that identifies the different possible classifications of signs in the database with that form of the hand. Each classification describes the hand shapes and orientation, expressed in HamNoSys.



Hand Window

Having defined the manual description of the signs, we proceed to describe the non-manual, which is structured according to the following schedule:

- Movement of body parts (Window "*Limbs*").
 - Movements of the shoulders.
 - Movements on the body.
 - Nods.
- Boca (Window "*Mouth*").
 - Gestures of the mouth.
 - Movements of articulation of words.
- Facial expressions (Window "*Face*").
 - Eye movement.
 - Eyebrows.
 - Eyelids.
 - Nose.
- ***Movements of body parts***

In the "*Limbs*" can define the relative movements of the shoulders, body, and head.

9 You can define different **shoulder movements**, both static and dynamic: shoulders raised, drawn forward, shrug, and so on. The movements of the shoulders should be aligned with body movements when necessary.

As for the **relative movements of the body**, can be defined 10 distinct movements, and, as in the case of shoulder movement, both static and dynamic. They refer to body rotation, tilt, etc..

Finally, you can define 11 different **head movements**, both static and dynamic. A part of nodding and deny other movements can be defined as nods, turns, and so on. The movements of head and eyes are not independent, in some movements look to remain static, while in others the head is oriented according to the direction of gaze. This factor was taken into account when designing the editor. Furthermore, head orientation (right / left) can be also related to body orientation (rotated right / left) and shoulders.

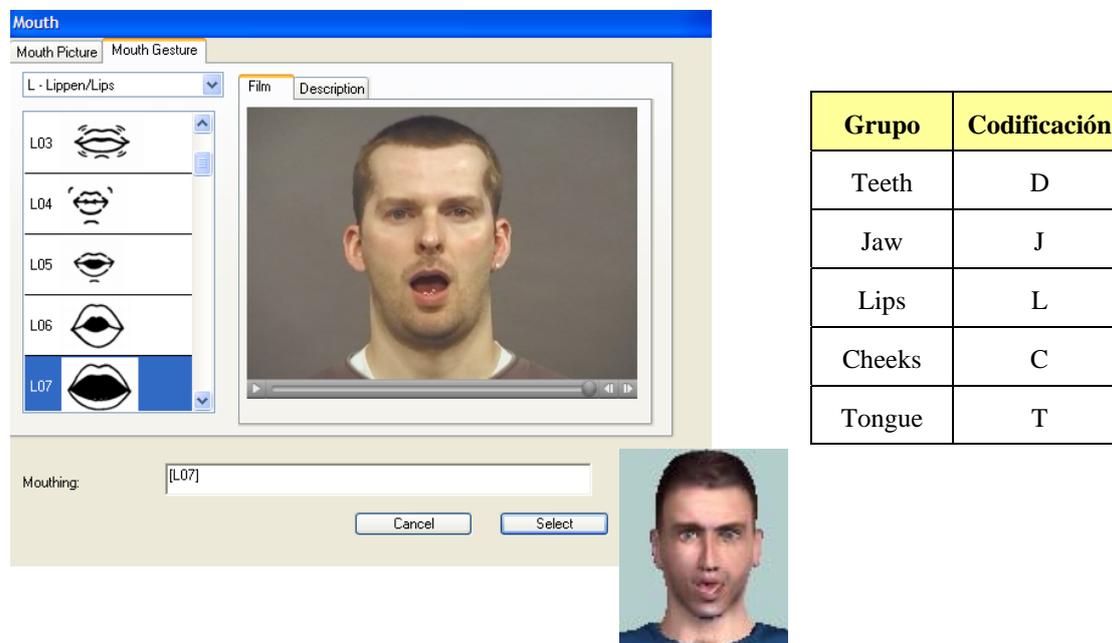
- ***Mouth movements***

The movements of the mouth may include mouth gestures or movements of articulation of words, from the spoken language. The latter used primarily the lips and tongue, while the movements of the jaw and teeth subordinate to them. However, the gestures of the mouth used in addition to the lips and tongue, teeth and cheeks, and jaw movements is not limited to top down.

In the "*Mouth*" can choose between two alternatives. To describe the movements of articulation of words has used the SAMPA encoding¹. You can enter directly description SAMPA, or use the pronunciation database, type a word in natural language and converting it to automatically SAMPA.

As for the gestures of the mouth, divided into several groups according to the main articulation: teeth, jaw, lips, cheeks and tongue. In total there are 71 gestures, both static and dynamic. Are coded by an uppercase letter for each group, followed by two

numbers for each move. This code is placed in brackets to be used with SAMPA. By selecting one of the possible gestures, showing a video that you can view both the gesture as a text description ([Figure 23](#)).



Grupo	Codificación
Teeth	D
Jaw	J
Lips	L
Cheeks	C
Tongue	T

Description of mouth movements

The gestures of the mouth, usually performed during the same time that the representation of the sign manual. If manual representation ends before the end of the manual no representation, there is a pause in the representation of the signs, until the manual no representation ends. If in the next period is not made any gesture with his mouth, it returns to its neutral position (closed mouth) before the start of the next segment. However, if the next time a gesture is performed with the mouth, there is a direct transition between the first and the second gesture, unless the first end soon, before it has finished rendering the sign manual. In this case, mouth back to the neutral position and perform the second act when he began to represent the second sign. This behavior can be changed by the **HOLD** command, which saves the final state of the gesture of the mouth during the entire segment, until you start the next. In general, HOLD can extend the value of any parameter in a segment.

- **Facial expressions**

In the "Face" can be defined the direction of gaze, and gestures made with the eyebrows, eyelids and nose, that is, every facial expression, except through the mouth.



VGuido facial expression

The **gaze direction** can take one of 11 values different, both static and dynamic, referring to gaze upward, downward, away, towards the hands, etc..

The gestures made with the **eyelids, eyebrows and nose** (see Table 1, Table 2 and Table 3) may be part of complex facial expressions (for example, the expression of fear), or serve as indicators of grammar (eg in questions).

Code	Action	Type of movement
RB	Raise both eyebrows	Static
RR	Right eyebrow lift	Static
RL	Eyebrow lift	Static
FU	Frown	Static

1. Table of possible movements with his eyebrows

Code	Action	Type of movement
WB	Eyes wide open	Static
WR	Right eye wide open	Static
WL	Left eye wide open	Static
SB	Both eyelids almost closed	Static
SR	Almost closed right eyelid	Static
SL	Left eye almost closed	Static
CB	Eyes closed	Static
CR	Closed right eyelid	Static
CL	Closed left eyelid	Static
TB	Both lids tightly closed	Static
TR	Tightly closed right eyelid	Static
TL	Tightly closed left eyelid	Static
BB	Flashing (late sign)	Dynamic

2. Table of possible movements with lids

Code	Action	Type of movement
WR	Wrinkle your nose	Static
TW	Repeated movement of the nose	Dynamic
WI	Fully open holes	Static

3. Table of possible movements with your nose

Thus, facial expressions refer to the top of the face, so that the representation of most grammatical expressions (questions, conditionals, negation, etc.). Placed on it, while the mouth is devoted primarily to the lexical expressions.

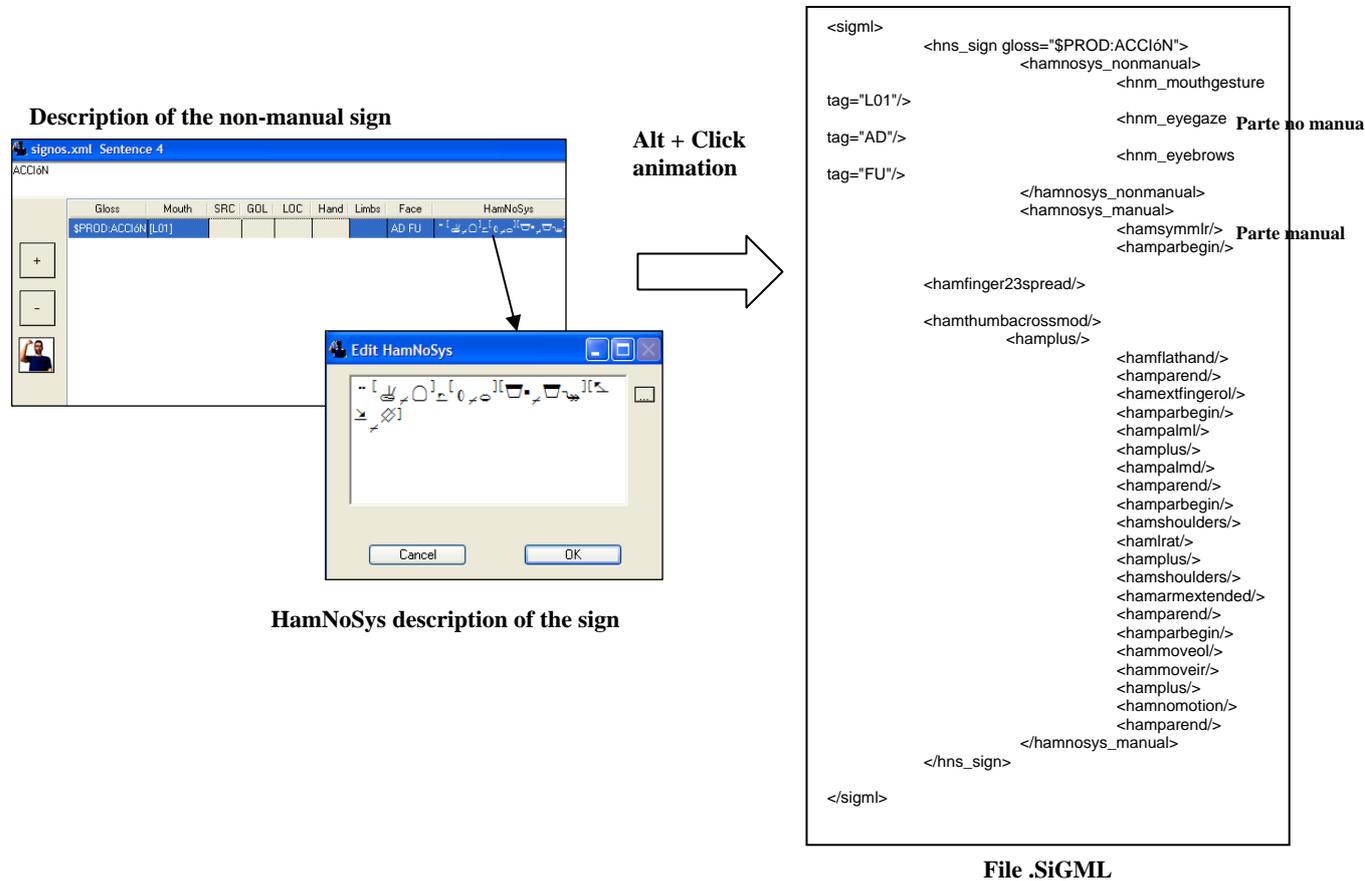
For a more detailed description of the editor can see the documents "*Deliverable 2.3: Intelligent Sign Editor*" [3], provided by installing the software publisher, and "*Deliverable D5.1: Interface Definitions*" [6], which describes in detail the various movements collar.

1.4.2 Tutorial. Generating a sign with the Editor ESIGN

To generate a sign with the editor you must follow the steps below.

1. Each document is used to store an unsigned text. First, you must create a new document from the "*New Document*" in the "*File*" menu.
2. Create a new sign or phrase marked by clicking the "+" button.
3. Open the window to describe each individual sign, double-clicking on the right hand row of the document.
4. Add new signs, clicking on the "+".
5. To describe the signs, we must take into account the following considerations:
 - First it is described HamNoSys the sign. This begins by establishing the symmetry (if the sign is represented with two hands). The following are the parameters of shape, orientation, location and movement, in that order. The parameters are different for the dominant hand and nondominant introducing brackets, separated by the symbol \surd .
 - Once defined, the description of the sign manual, click on "*Select*" button, which closes the window HamNoSys description, and proceeds to describe the non-manual: mouth, face, body, etc.. For this, double click on each individual cell, which will display the window for the parameter to modify (if permitted, ie if the cell is not gray).
6. Click the animation button while holding down the Alt key, which is generated the file. SiGML concerning the description of the sign HamNoSys with non-manual features.

For example, in the following figure shows the process to follow for the generation of the sign "action."



Generation process of a sign

1.5 ENTERTAINMENT DATABASE

From sign vocabulary defined in the database of the translation system (Table 3 chapter 3) for the training sentences and test sentences, we have generated a database of animations of signs. This database contains 320 signs, containing the vocabulary of the sentences of the training and test sentences.

To generate the signs have been used mainly two sources: the dictionary of signs "*Dictionary of the Spanish Sign Language*", by Félix-Jesús Pinedo Peydro [7] and the thesis "*Sign Language*" by María Ángeles Rodríguez González [8]. In addition, websites have used Sign Language with on-line dictionaries ([9], [10]). Approximately thirty vocabulary signs do not appear in any of these sources so that their representation has consulted with an expert translator sign language. These thirty signs were generated in two working sessions with the translator, five hours each.

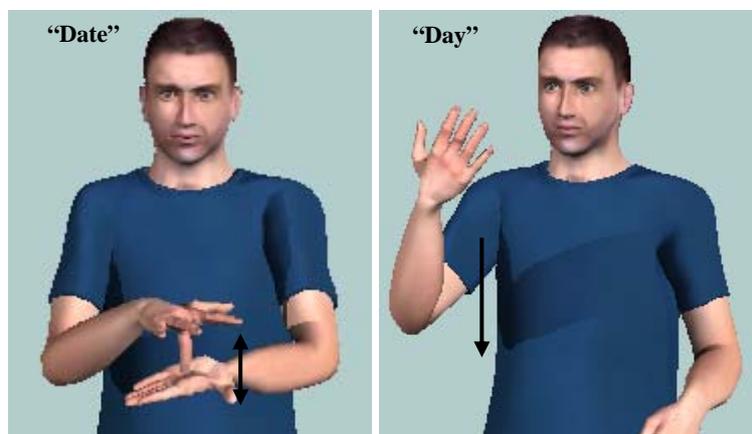
Besides vocabulary of 320 signs, a sign has been generated by default, "DEFAULT", for if the agent does not recognize the sign encouraged to play.



Representation of the sign of "DEFAULT"

Signs have been generated by ESIGN editor, using the notation HamNoSys. Every file. SiGML ESIGN generated with the publisher, is stored in the database as a .Txt with the name of the sign in question. In this way, the signs are stored and may be modified or viewed by VGuido.

In some cases there are ambiguities in representing a sign. For example, for the sign "when", there are two representations, one where the sign refers to the past and another when it comes to the future. After an analysis of the translated phrases, has represented the sign referred to the future, which is the most frequently used phrases in the database. The same situation occurs with the "day" may refer to the concept of "24 hours", or the concept of "date". After analyzing the translated phrases, have been found to be using "DAY" referring to a date, so we used the sign described under this heading.



Symbols representing "day" and "DATE"

In other cases, the representation of the sign in the dictionary or the thesis does not match the concept to be expressed. For example, the dictionary defines "FUND" and "bottom of a container, and yet, in the sentences of the database refers to the background of a photograph. It gives the same situation with the "public," which the dictionary refers to "all persons" and in the context of the phrases in the database refers to "public office" or "public defender". The correct representation of the signs have been consulted with expert translator.

It is worth noting the case of verbs ending in reflective particles ("me", "te", "se", etc..) Or reciprocal, and that this is an extension of the sign assigned to the verb. For example, in the following figure shows a representation of the sign "delivery", which corresponds to the representation of the sign "GIVE" followed by a move to the issuer, which identifies the particle reflection.



Representation of the sign "Submissions"

Between two equal signs, you must enter a pause (for example, you BREAK You). This sign is represented PAUSE leaving blank PAUSA.txt file, thereby generating a short pause between the two signs.

Finally, it is important to describe the representation of the sign, "plural." The plural sign can be represented in three ways: by repeating the sign several times, repeating the sign with both hands (if the single sign on using one hand), or by the sign "MANY". In this case it was decided to use the latter option, be easier to implement.



PLURAL sign representation

1.6 LIMITATIONS ON THE REPRESENTATION OF THE SIGNS

While performing the task of generation of the signs have been some VGuido environmental constraints in the representation of signs. This section describes these limitations, and solutions used to represent the signs concerned.

The animated agent is not designed to withstand some of the transcripts HamNoSys, so ignored, or not to move. Similarly, when a sign on HamNoSys transcribed with an error of notation, generates a file. SiGML the animated agent can not represent, so that does not produce any movement.

- ***Generation of signs with both hands***

When building signs with both hands, we must define the shape, orientation, location and movement for each hand. If the behavior of both hands are identical, the description is HamNoSys as for the signs with one hand, but preceded by a symmetry. However, if some aspect hands behave differently, this should be indicated by entering a description HamNoSys between two brackets separated by the symbol (\sphericalangle). The description of the dominant hand is on the left of the symbol (\sphericalangle), and that of the nondominant hand on the right.

For the animated agent represents the sign correctly, the location symbols can not be introduced in the same bracket that symbols of shape and orientation to be introduced in different brackets.

For example, the symbol "PUT" HamNoSys transcribed in the shape, orientation and location described by the following notation:



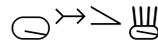
If the location symbols were introduced in the first bracket, it could not represent the sign.

- ***Change in the way of the hand, extend or close a finger after another***

The symbols allow \succ HamNoSys \prec and transcribe those signs where the hand shape changes from fist open hand or vice versa, extending / bending the fingers one by one, one after another, starting with the pinkie or the thumb according to the command entered.

However, to introduce these symbols in the description of the sign, the agent not only VGuido animated the movement described above, but acts as if the description of the sign was wrong, and makes no movement.

Thus, to implement these changes, it has changed the shape of the hand by step, extending / bending at each step the corresponding finger. For example, the sign "ANY" form of the initial deal is closed, and fingers will extend one by one, starting with the little finger to have an open hand. The ideal would be to implement in the form:



But given that this expression is not valid for VGuido representation has been due to implement in stages, extending a finger on each step:



The transcript begins with HamNoSys used the closed hand. Here lies the little finger, and the next step, describes the shape of the hand with the pinky and ring finger extended. After extending the little finger, ring and heart, so as to transcribed with the open hand symbol, but with the index finger flexed. Finally, it describes the shape of the hand fully opened. This process is shown in the following figure.



Representation of transitions of the sign "ANY"

- ***Thumb between two fingers***

With the closed hand, thumb, two fingers may be between using expressions like $(\bigcirc_{\text{finger1} \setminus \text{finger2}})$, where behind the symbol that transcribes the shape of the closed hand, indicated that the fingers between the thumb should be placed.

However, introducing this expression in the description of the sign, VGuido ignores it, leaving the thumb in the position indicated on the transcript of the shape of the hand.

This limitation has not been resolved in any way, so that the thumb was left closed most appropriate option from among the possible options of thumb position.

- ***Shift in the hand during movement***

In some signs, the orientation of the hand changes constantly with the movement, maintaining a constant relationship between the orientation of the base of the

forefinger / orientation of the palm and the path of movement. This feature is indicated by the symbol: (~).

However, by introducing this symbol in the description, it ignores the animated agent, acting as if it were not. The signs in which there is a change of direction with the movement must be implemented manually, by successive changes of direction and location that allow properly represent the sign.

For example, the sign "ATTACH" the right hand describes a curved movement down and to the left, in which the orientation of the palm of the hand follows the movement. HamNoSys could be recorded in as:

.. 0_△_○ [▮_ ▮_ ▮_] ◀ ▷

However, this transcript does not generate the correct sign, the movement is performed, but the orientation of the palm of your hand does not change with it. To fix it, the sign described in steps, in the form:

.. 0_△_○ [▮_ ▮_ ▮_] [→_ 0_ ▮_ ▮_ ▮_] [→_ 0_ ▮_ ▮_ ▮_] [→_ 0_ ▮_ ▮_ ▮_]

The representation of each of the transitions in the description of the sign shown in the figure below.



Representation of transitions the sign "Attachments"

- **Relocation of hands**

Movements directed at a particular location can be transcribed by the symbol HamNoSys → introducing left the original location, and right the final.

If the hand changes shape or orientation in addition to location, there is no problem in the representation of the sign, but if you just change the location, the animated agent

is not responding. So, before indicating the final location, you should always indicate the shape or orientation of the hand, but not make any modification on them.

For example, the symbol "FOR" is transcribed by the following description HamNoSys:

.. 0 [0 0 1 1 1 0] [0 0 \ 0 0) (0 0 \ 0 0) ([0 > 0 ~ (X 0 ~)] [0 / 0]

Change location

In the highlighted portion shows that there is only a change of location of the right hand, but for the sign is represented correctly indicated the orientation of the palm, but does not vary with respect to the initial one.



Change of location of the hand in the representation of the sign "TO"

- *Location of the fingers*

In some signs, the hand is placed so that a finger is in contact with a body part, and one finger to another. To implement this situation, you should simply introduced each of the locations of contact, followed by the finger with which it touches.

For example, a sign in which the index finger touching the left side of the nose and the right thumb, would describe the form:

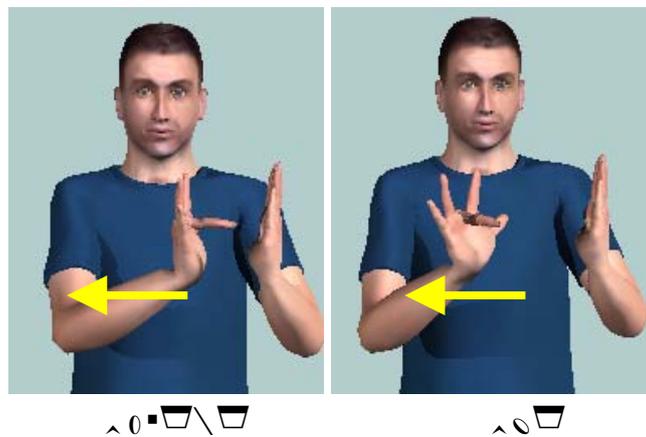
■ 0 (X 2) 0 ■ (X 1)

However, when this expression is introduced into the system, the agent poses no VGuido movement, taking the word as incorrect. Thus, to represent this kind of signs are due to choose the other parameters (hand shape, orientation and location of the hand) in an appropriate manner so that the result is similar to that represented.

- *Wrist movements*

Unable to perform wrist movements (up-down, left-right and rotation) while movement is being made straight, curved or circular.

The signs in which the wrist moves while a shift of the hand, this shift has taken place in steps, changing the orientation of the palms and location. For example, the sign "GLOW", right hand moves to the right while there is a rotating wrist (Ψ). As it is not possible to implement this type of movement has changed the orientation of the palm in several steps and as location, moving to the right hand at each step. In [Figure 33](#) shows two steps of the process, repeated several times in succession, changing the location to the right.



Representation of transitions the sign "GLOW"

- **Fingerplay**

In theory, the *movement fingerplay* "could" apply only to specific fingers. For example, signs with hand shapes (∂) rate should be possible to move the fingers extended only through the expression ($\partial^{(3\ 4\ 5\ \text{✎})}$).

However, by introducing this type of expressions in the system, the agent poses no VGuido animated movement, taking the word as incorrect. Since this type of movement can not be implemented in steps, as in previous cases has been due without it, or introduce it to all the fingers, taking the most appropriate option depending on the sign to represent.

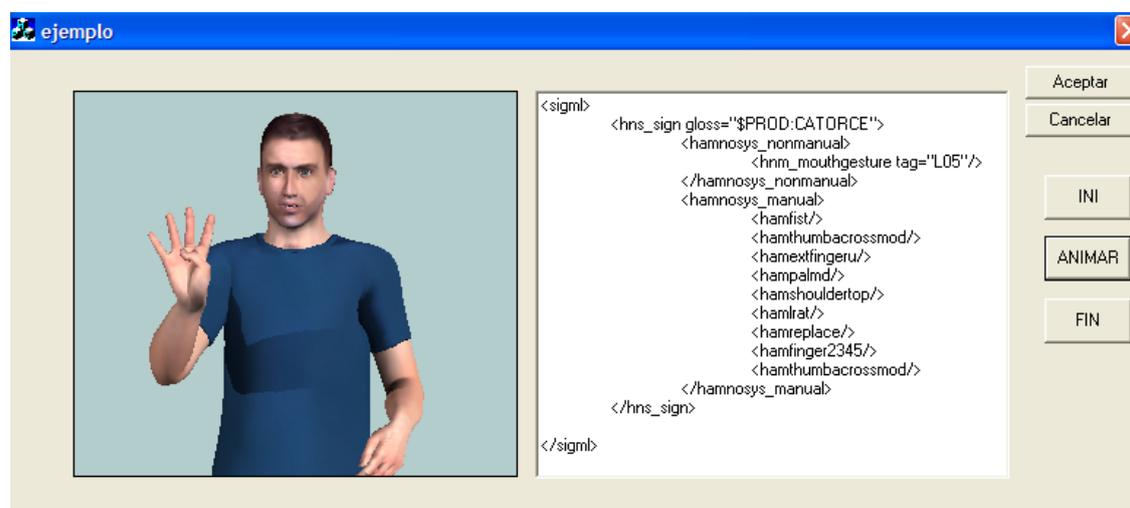
- **Head and body movements.**

The animated agent is unable to represent the head and body movements, which are defined in the "Limbs". Although the translation of the symbols in HamNoSys to SiGML succeeds, VGuido ignores these symbols, representing the sign as if they were not.

Thus it has been because without these movements, which, on the other hand, are less relevant to the representation of signs than other non-manual movements, facial expressions and gestures of the mouth.

1.7 REPRESENTATION OF THE SIGNS

In order to represent the signs of a quick and easy way, we have implemented the "example" in Visual C++. When run, it generates a window where you enter text directly in SiGML with HamNoSys description for the sign to represent, which is visualized by the animated agent VGuido.



Program "example" for representation of signs

The figure shows how the SiGML representation enters the right side of the window, while the left is displayed VGuido. To initialize the program and load VGuido you must press the button "INI" and to represent a sign, should click "animated." If you press the buttons "OK" or "Cancel" the representation is terminated and closed the program.

Below are listed and briefly described the various source files used to implement the program.

- *ejemplo.cpp* (*example.cpp*)

It is the main source file that contains the application class, "CEjemploApp."

- *ejemplo.rc*

This file is a list of all resources used by the program. Includes icons, cursors and drawings that can be edited directly in Microsoft Visual C++.

- ***ejemplo.es***

This file contains the icon used as application icon, which is included in the master file of resources, "*ejemplo.rc*".

- ***ejemplo.rc2***

This file contains resources that can not be edited by Microsoft Visual C + +. In this program has not changed any resources used externally, and therefore do not use this file.

- ***hnstplayerctrl.cpp***

This file contains the necessary methods to visualize and animate the virtual agent as an ActiveX control. A brief description of these methods.

- ***GetFrameRate*** (). An avatar animation generated by a temporal succession of static images ("*frame*"), each of which represents a position of the animated agent. With *GetFrameRate* method yields the rate of *frames* per second set to represent a sign.
- ***SetFrameRate*** (*short nNewValue*). This method is used to set a rate of *frames* per second for the representation of signs.
- ***PlayHNST*** (*LPCTSTR bsHNST*). By this method, the agent performs lively animation file. SiGML with HamNoSys description for a sign. This. SiGML is contained in the string that is passed to the method as an argument.
- ***Replay*** (). Calling this method represents the animated agent again made the final animation.
- ***ResetCamera*** (). In implementing this method, the position from which one observes the agent returns to the initial animated.
- ***Initialise*** (*long t*). This method loads the corresponding animated agent. It has several well VGuido agents, indicating the avatar to be loaded through the number that is passed to the method as an argument. A VGuido rightful number 6.
- ***PlaySiGML*** (*LPCTSTR bsSiGMLIn*). By this method, the animated agent represents the sign described in the file. SiGML contained in the string that is passed as an argument.
- ***SwitchAvatar*** (*long t*). This method lets you change the displayed animated agent.

- ***ejemploDlg.cpp***

The dialog is generated from source file "*ejemploDlg.cpp*" which contains the class "*CejemploDlg*". The staffing of the dialog is in the resource file "*ejemplo.rc*" and can be edited in Microsoft Visual C + +.

The class *CejemploDlg* "defines the behavior of the dialog box, setting the actions to take when you press the buttons" INI ", " END "and" animated. " Pressing the button "INI" animate agent is loaded through the method "*Initialise*" as defined in the source file "*hnstplayerctrl.cpp*" and may indicate in the code to display the virtual agent.



Possible animated agents that can be displayed

This ability to choose among various actors is a sign of the flexibility of the system, although the representation is optimal VGuido signs, which is the most successful and get more features that support (facial expression, mouth movements, etc.).

Pressing the button "Anime" method is called "*PlaySiGML*" as defined in "*hnstplayerctrl.cpp*" to represent the file contents in SiGML string "*codigo_ejemplo*." Variable is stored in this file. SiGML for the sign what interests they represent, through the method "*carga_ejemplo*" as defined in "*ejemploDlg.cpp*".

Finally, the "END" has no functionality in this application, so that when pressed does not run any action.

The program implemented representation of signs are used files. SiGML obtained directly from the transcript HamNoSys the sign, but we can comment that VGuido software incorporates an HTML document for displaying the representation of the conditions listed in a file Extended SiGML. The representation of the signs through VGuido can be viewed through the HTML document "*Camera-Control-JavaScript-VGuido*", located in Program Files / ESIGN / SiGMLSigning, after installing the agent software animated. In the. SiGML "*Camera-SiGML-Demo*" Program Files / ESIGN / SiGMLSigning / Files can be modified to represent the sign.

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