An Animator of Gestures Applied to the Sign Languages

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Abstract

Motivated for to the expansion of the Internet and the increasing development of Web technologies and for a great number of people with distinct necessities search at that the information they need, we try to attend the deaf community by development an Animator of Gestures applied to the Sign Languages, the AGA-Sign, with the goal of assisting practical writing of signs and in the familiarization with the language. This work presents an application for automatized generation of animations of gestures applied to the Sign Languages from texts written in SignWriting. The used signs for the development of the application had been elaborated from the LIBRAS and the animations had been generated through model AGA (graphical animation based in the Automata Theory).

1. Introduction

The Internet widespread and the increasing development of technologies to the Web join a great number of people with distinct necessities searching the information that they need, using the Internet as a way of education and learning.

The diversity of people who use the Internet as part of education, researches search to develop technologies, methodologies and tools look forward the necessities of these people, particularly the deaf people, for example, (Costa, 2004; Informatics & Telematics Institute, 2004; FIAP, 2004).

Considering the significant number of the special individuals, that according to Census of 2000 of the Brazilian Institute of Geography and Statistics - IBGE, are 5.685.956 special individuals ith educative necessities - PNNE, with hearing difficulties in Brazil, 2002 the National Congress and the Presidency of the Republic had approved and confirmed the Law n.º 10.436, of April 22th, 2002, that recognizes the LIBRAS (Língua Brasileira de Sinais), Brazilian Sign Language, as legal way of communication and expression of the deaf community, and that stimulates the schools to accept as educational resource.

According to Stumpf (2000), the deafness is a difference that makes of its carrying people who pass to communicate of essentially in a visual form, therefore is perfectly a compatible form to the use of the computer as educational tool, which become the equipment and the technology of information processing essencial instruments in the education of deaf people.

In this article presents a model for the automatized generation of animations of gestures, applied to the Sign Languages and the vision of the use of this system, as for example, the aid in the teaching and learning process of deaf people.

We adopted the *SignWriting* system, which can be used for register the written of any Sign Languages, of any country of the world.

From studies carried through on the *SignWriting* and its contribution with the deaf community, considers it generation of animations of signs written in *SignWriting* in Web environment. To generate the animations, we use the animations model based in the Automata Theory, called AGA (Accorsi, 2000), originating the language of AgaML description (AGA Markup Language) (Magalhães, 2002), that structure the animation content in automatons that describe the behavior of synthetic actors during the animation, where each synthetic actor is controlled by a proper automaton. The model for signs animation is called AGA-Sign (Animator of Gestures Applied to the Sign Languages).

The paper is organized as follows. In section 2, we review aspects of the LIBRAS and sumarize the main features of the *SignWriting* system. Section 3 presents the animation model, the AGA-Sign, describing the tools that are part of the model. Section 4 presents the contribution of the AGA-Sign in the teaching and learning processes of deaf people. Section 5 brings the conclusion.

2. LIBRAS and the *SignWriting* system

The Sign Languages used by the deaf people are not universal, each country possess its Sign Languages, with proper grammatical structure and having influences from the native culture (with state and region variations and between specific groups with its slangs). The language condition is attributed to the Sign Languages, and not to an artificial code or simple sets of mimic gestures, because they are composed by the same linguistic levels of the verbal languages: the phonologic, the morphologic, syntactic and the semantics (FENEIS, 2005).

The fact to be used a form of communication and expression of appearance-motor nature, and not of verbal-auditory nature as the verbal languages; do not hinder the Sign Languages to consist in complete linguistic systems

for transmission of ideas and facts, concrete or abstract. In Brazil, the Sign Languages is called LIBRAS (Brazilian Sign Languages).

The word equivalent or lexical item, in the verbal-auditory languages is called of sign in the Sign Languages. The signs are formed by way of the combination of forms and movements of the hands and control points in the body or the space.

In the Sign Languages the following parameters can be found that will form the signs:

- Hands Configuration: They are forms of the hands that can be the manual alphabet or other forms made by the predominant hand (right hand for the dexterous or left for the left-handed people), or by the two hands.
- Point of joint: it is a place where the configured predominant hand takes place, or either, place where the sign is made, being able to touch some part of the body or to be in a neutral space.
- Movement: The signs can have a movement or not. The movements can be internal to the hands (movements of the fingers) or displacements of the hands in relation to the body.
- Face and/or corporal expression: Corporal the face expressions/are of basic importance for the real conformity of the sign, being that the tune in Sign Languages is made by the face expression.
- Orientation/Direction: The signs above have a direction in relation to the parameters. Thus, the verbs TO GO and TO COME (Figure 1) if oppose in relation to the direction.

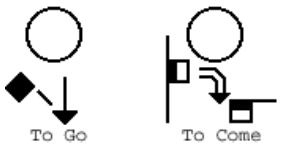

Figure 1: Signs To Go and To Come

The Law N° 10.436, in its article 4º determined and confirmed in 24 of April of 2002 state the following: "the federal educational system and state, community educational systems and of the Federal District must guarantee the inclusion in the formation courses of Special Education, Phonoaudiology and Teaching, in its levels average and superior, of the education of the Brazilian Sign Languages - LIBRAS, as integrant part of the National Curricular Parameters - PCNs, as current law".

About LIBRAS, however, it is not enough to know the signs separately, it is necessary to know the grammatical structure of the phrases of this language, as well as the resources of dialogue.

As cited before, the animation of gestures can be applied to any Sign Languages. However, in this work the signs used belong to the LIBRAS, for being the native language of the Brazilian deaf people.

In this paper, the signs were writing with the *SignWriting* symbols.

The *SignWriting* was created by Valerie Sutton founder of DAC (Deaf Action Committee), a system of writing for Sign Languages (Sutton, 1990).

It was developed to be a form of written for Sign Languages, as well as the diverse alphabetical, syllables notations and ideographic of written forms of verbal languages. An evident and decisive difference, however, is that the last ones had a development of historical character, to the step that *SignWriting* rationally was conceived, being, therefore a formal language. The graphical expressions of the *SignWriting* (Figure 2) restrict to describe movements (physical), as well as face expressions, and not meant it of the signs, making with that the system can, therefore, to represent any Sign Languages.

Further than the graphical character, the *SignWriting* was conceived to be registered in fixed way, in paper. This reflects inside in its more than enough repertoire of dedicated symbols to the representation of the dynamics of the corporal elements in game of the signs (Costa, 1997).

Figure 2: Example of the SignWriting symbols

The *SignWriting* is used in more than thirty countries and in Brazil it started to be used in 1996. It had been formed work groups with no deaf people and deficient in hearing for the diffusion of the system and education of the reading and the writing of the deaf community. The research groups had also been formed to assist in the development of tools that make use of the system, between which it is in case the described system in the present work.

The application of the *SignWriting* to the LIBRAS producing the Brazilian sign writing supplies as adequate tool so that the deaf students fulfill the objective to register for writing its visual language. The productions of signs are made through editors who display *SignWriting* symbols.

3. AGA-Sign

In this section, we present all the tolls that integrate the AGA-Sign, as Figure 3.

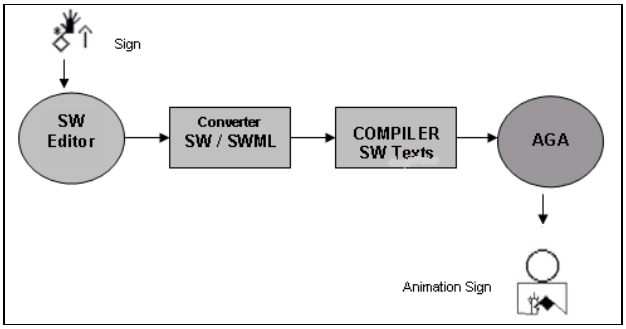

Figure 3: AGA-Sign Model

3.1. *SignWriting* Editors

The signs are represented through editors who process signs in visual way with *SignWriting* symbols, making possible the users of the Sign Languages to be able to write texts in its native language. They make use of symbols of movements, face format of hands, expressions and still a Dictionary of Sign Languages, where the users can store signs, copy them and stick them in documents while they type.

The SignWriter program (Sutton et. al., 1995), the first computer editor for sign languages, defined such an encoding for *SignWriting*.

In this work the signs had been produced in SW-Edit Editor (Torchelsen et al 2002) whose one of the differentials in comparison with others publishers are that it makes possible that the archives are safe in SWML (presented in the next subsection).

3.2. Converter SW/SWML

To suit possible the use of the *SignWriting* system in WWW pages a converter SW/SWML was developed. SWML (Costa, 2005) is a proposal for a general encoding format for *SignWriting* documents, using XML-based markup language for Sign Language Processing, for the storage, changes and processing of texts of the *SignWriting*. With the SWML the document interchange is possible between different programs, the independent analysis of texts of the publisher and also it serves as a format of storage of texts.

After the edition of the signs, the archives of resultant signs are converted for texts SWML, generated for Converter SW/SWML. A text converted into SWML presents the position, rotation, variation, fill and shape of each symbol, as it shows the Example 1.

Example 1 *The SWML representation of LIBRAS sign for* To Show *(written as in Figure 4) is:*

```
<signbox>
    <symb x="53" y="57" x-flop="0" y-flop="0" color="0,0,0">
      <category>01</category>
      <group>05</group>
      <symbnum>001</symbnum>
      <variation>01</variation>
      <fill>03</fill>
      <rotation>01</rotation>
    </symb>
    <symb x="50" y="79" x-flop="0" y-flop="1" color="0,0,0">
      <category>01</category>
      <group>01</group>
      <symbnum>001</symbnum>
      <variation>01</variation>
      <fill>01</fill>
      <rotation>02</rotation>
    </symb>
    <symb x="74" y="69" x-flop="0" y-flop="0" color="0,0,0">
      <category>02</category>
      <group>05</group>
      <symbnum>001</symbnum>
      <variation>02</variation>
      <fill>03</fill>
      <rotation>01</rotation>
    </symb>
    <symb x="30" y="64" x-flop="0" y-flop="0" color="0,0,0">
      <category>02</category>
      <group>01</group>
      <symbnum>001</symbnum>
      <variation>01</variation>
      <fill>01</fill>
      <rotation>01</rotation>
    </symb>
</signbox>
```

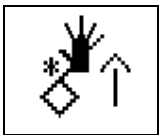

Figure 4: Sign To Show

3.3. Compiler of *SignWriting* Texts

In this section presents an important stage of this work, the detailed study of the *SignWriting* symbols for to know its characteristics and its meanings.

The *SignWriting* symbols are classified as its categories and follow a specific order, called of the SSS (Sign-Symbol-Sequence) (Table 1) and represented for

SSS = (C, G, S, V, F, R)

and represents respectively: *Category*, *Groups*, *Symbol Number*, *Variation*, *Fill* and *Rotation*.

Symbol	C	G	S	V	F	R
*	02	01	001	01	01	01

Table 1: SSS of a SignWriting symbol

Actually, the *SignWriting* symbols are organized in ten categories, as Figure 5.

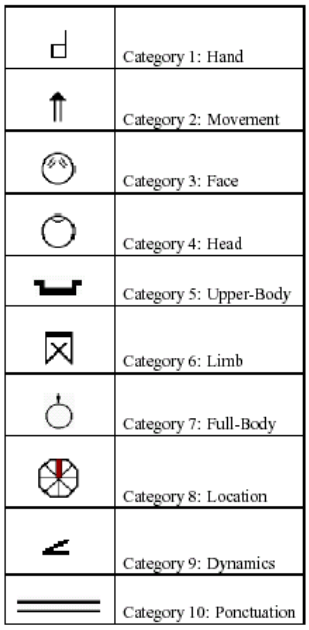

Figure 5: SignWriting Categories

The texts written in *SignWriting* are storages in archives of signs. To visualize the SSS of the symbols that compose a sign, we use the Converter SW/SWML. The SWML documents list all the information of the sign writing in *SignWriting*, suiting possible the analysis of the

symbols that are parts of sign. From the knowledge of the symbols and its characteristics, mainly of the movements, it is possible to determine some rules that will be responsible for the animation of the signs.

The movement symbols can represent displacements: rectilinear vertical or horizontal lines; circular horizontal or vertical; and arched horizontal or vertical (Figure 6).

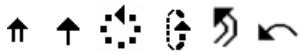

Figure 6: Example of the movement symbols

The movement symbols can be modified to indicate particular aspects of a represented movement, as the greater or minor covered distance (Figure 7), or the direction of the movement (Figure 8).

Figure 7: Example of the variations of vertical movements

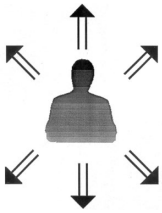

Figure 8: Example of the rotations of vertical movements

For example, the sign presents in Figure 9 have a short displacement of the hands, represented for the vertical movement symbol with *variation* 1.

Figure 9: Writing of the sign To Cry

The hands displacement is represented in the Figure 10, where P_i is the initial position and P_f is the final position of the hands.

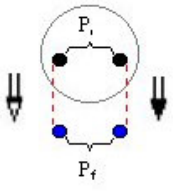

Figure 10: Displacement for the sign To Cry

Then, from variation and rotation is possible to know the direction and the displacement of the object during the animation of the sign. The rule that define this movement is represented in Example 2.

Example 2 *Algoritmic example of the rules for vertical movements.*

```
if (movement = vertical) then
    if (variation = short movement) then
        d ← distance equivalent to the short displacement
        if (rotation = arrow for low) then
          displacement of the object ← (xi, yi - d)
        end if
    end if
end if
```

The displacement of the object happens through of the initial position of the object (x_i, y_i) increased or diminished of the equivalent distance to movement (short, medium or long). In Example 2, the displacement of the object is for low, on the vertical axis (y), not modifying the position on the horizontal axis (x).

The goal of the Compiler of *SignWriting* Texts is the generation of a document that serves as input archive for AGA animator. From the reading of a document SWML the symbols are interpreted and, as the rules, the Compiler generates an AgaML document. This document presents the actors specification, tapes and instances for the AGA actors. The AgaML and AGA model will be presents in next subsection.

3.4. AGA

The model of animations for Web, called AGA (Graphic Animation based on Finite Automata) (Accorsi, 2000) based on the Theory of the Automatons is used to generate the animations. The AGA specifies the animation from a set of actors (objects) and its respective variations during the animation. The specifications in AGA are supported by a formal model based in automatons with exit (Hopcroft et al 2000; Menezes, 2005).

In the AGA, the animation actors are specified through an extension application for the automaton with exit, which attach the variations in the graphical form of the actor from the output of the automaton. In this way, when the automatons are simulated, by means of the reading of an input tape, the transitions between its states control the actor's animation (Accorsi, 2000). In the Sign Languages animation each symbol represents an actor, as Figure 11 and Figure 12.

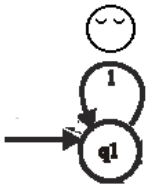

Figure 11: Head Actor specified in AGA.

The Figure 11 and 12 illustrates the basic structure of model AGA specification applied to an actor animation. The symbols are of the To Cry Sign (Figure 9). The actors are specified from automatons with exit where graphical representations are associates to the transitions. These representations correspond to the graphical variations that the actor can suffer during the animation. Of this form, when the hand-right actor carries through a transition of state 1 for state 2, the graphical representation of the actor

presented in the animation is modified by the hand-right with bended finger.

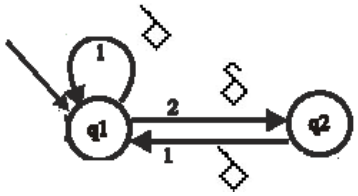

Figure 12: Hand-right Actor specified in AGA

The choice for the AGA was given due the characteristics that facilitate its application in the specification and control of animations in the Web, which can be cited: storage space has supported the recovery of information and maintenance of the content of the animations. From the AGA it originated language of description of the called animation AgaML (AGA Markup Language).

The AgaML organizes the specification of the animation from three basic components: the specification of AGA actors (Example 3), the specification of input tapes (Example 4) and the creation of the instances of the actors (Example 5). The instances can be understood as the association of the specification of an actor AGA with an input tape. The specifications of the actors can be used by some different instances, as well as, can be shared by diverse animations if be stored in independent archives.

Example 3: *Element ACTOR for the specification of the hand-right actor (Figure 12).*

```
<ACTOR ID = "hand-rightact" TYPE="GRAPHICS"
STATES="2" SYMBOLS="2">
    <OUTPUT ID="1" SOURCE="01-01-001-01-01-02.gif"
    x="180" y="160"/>
    <OUTPUT ID="2" SOURCE="01-01-007-01-01-02.gif"
    x="180" y="155"/>
    <DESCF>
        <DESCRIPTION STATE="1"> Strained
    finger</DESCRIPTION>
        <DESCRIPTION STATE="2"> Bended
    finger</DESCRIPTION>
    <DESCF>
    <TRANSF>
        <FROM STATE="1">
                <TO STATE="1" SYMBOL="1"
            OUTPUT="1"/>
                <TO STATE="2" SYMBOL="2"
            OUTPUT="2"/>
        </FROM>
        <FROM STATE="2">
                <TO STATE="1" SYMBOL="1"
    OUTPUT="1"/>
        </FROM>
    </TRANSF>
</ACTOR>
```

Example 4: *Element TAPE for the specification of the input tape.*

```
<TAPE ID = "hand-righttape">
    <CEL SYMBOL="1" TIME="50"/>
    <CEL SYMBOL="2" TIME="200"/>
    <CEL SYMBOL="1" TIME="50"/>
</TAPE>
```

Example 5: *Element INSTANCE for the creation for instances.*

```
<INSTANCE ID = "hand-rigth" ACTOR="hand-rightact"
ORDER="2">
    <USE TAPE= "hand-righttape"/>
</INSTANCE>
```

The program of visualization, AGA Player, was developed in JAVA in format applet and it is executed in the client to realize the reproduction of the animation, as the specifications in AgaML. Some examples can be seen in http://www.inf.ufrgs.br/~rmdenardi/aga/animacao.html.

4. AGA-Sign assisting in the education of Sign Languages

In Brazil, the LIBRAS started to be used in nineties. Because was the question of the Portuguese language, in relation the oral communication, be a very slow process in the communication of the deaf people. It was verified that the LIBRAS are a facilitator not only by the communication, but also of the dissemination of the information (Public Education, 2004).

Stumpf (2000), telling its experience on the use of the *SignWriting* in the Special School Concord, affirms that many deaf pupils when they learn to write think that the written Portuguese is the representation of the Sign Languages that they use. When the pupils start to learn the writing of signs they obtain to separate and to see that it is another language. The two languages working separately and comparing them the result it will be better because he is thus that the learning of one second language happens.

The deaf people can produce excellent materials in its written manifestations as: literature, poetry and texts, if possess the necessary control of the instrument. For the common, this does not happen in the Portuguese language because the learning difficulty of the verbal language for the deaf people is enormous.

For this reason, there is a great interest of the deaf people in learning the Sign Languages and, more recently, in using the *SignWriting* system.

The tools that become possible in the specification of the AGA-Sign, and the appropriate animator, contribute with the learning of the Sign Languages. In that the student says follow to the writing for the fact to be tools in which can produce the signs and store them in dictionaries of signs (editors) and to make animation them (AGA-Sign), assisting in practical of the writing of signs and the familiarization with the language.

The learner of the Sign Languages will also be able to use the animator as a verifier of correction of signs: in the doubt if the written sign he is or not what he does want to represent, the user makes animation the sign to have the confirmation.

5. Conclusion

The AGA-Sign, with its specification for signs animations through *SignWriting* symbols and the tools cited in the work, can be great allied in the teaching and learning of Sign Languages.

The generation of animations of signs through AGA model can contribute with the advance of the research in this area and for the insertion of the deaf people in the world of the technologies of the information, especially the Internet.

The application of the *SignWriting* to the LIBRAS producing the Brazilian writing of signs is an adequate tool so that the deaf students fulfill the objective to register for writing its visual language.

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