Deaf Culture and Sign Language Writing System – a Database for a New Approach to Writing System Recognition Technology

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Abstract

The Deaf have been denied their natural language for over a hundred years, with dire consequences for their health, citizenship and culture. Sign Language is the natural language of the Deaf, used for intellectual development and other human traits that are language related. Writing Systems (sequence of characters to represent a language) store and retrieve information for literature, science, knowledge creation, information dissemination, communication over time and space etc. SignWriting is a writing system deemed adequate to the spatial-visual nature of Sign Languages. However, current computational technologies fail to provide the Deaf with effective tools for their writing needs (they lack usability, and/or are one-to-one translation from the oral language etc.). This article proposes a new, more natural approach: that of using screen and stylus for online handwritten recognition of SignWriting. This research makes available a database to be used by computer vision/character recognition to inform design of SignWriting editors.

1. Introduction

Deaf people were once considered clinically deficient, and were subjected to procedures to “remove” deafness in order to become “normal”. The oral language became the de facto condition for social acceptance [1] [2]. However, the Deaf have the right to an identity, language and culture. They have the right to access the available human possibilities such as symbolic communication, social interaction, learning, etc. Sign Language, of visual-spatial manner, is the natural language of the Deaf, capable of providing complex linguistic functionalities. Deaf culture is the term applied to the social movement that regards deafness as a difference in human experience – rather than a deficiency [1] [2] [4].

Unfortunately, Deaf children who are born into non-Deaf families (90% of the cases) are unable to acquire the oral language, and they have little to no exposure to Sign Language [1] [2]. This lack of early language acquisition of a mother tongue causes severe consequences to the Deaf’s intellectual development, citizenship and culture [2]. The Deaf do not acquire basic concepts of daily life, and, therefore, do not develop the superior psychological faculties, a process that is mediated by language [3].

Quality education requires language. Additionally, it requires that children and adults be able to use their own language within the world in which they inhabit, both orally and written [59]. However, “many minority and indigenous people groups do not have that opportunity – quite simply because their language is not written down”. [59] goes on to point out that the lack of a writing system is another factor of marginalization, and that the use of a writing system of the mother tongue may interact with other factors to increase opportunities. Some of these opportunities are literacy and education for economic development; increased ability to learn other languages; chance for cultural expression and wider dissemination of cultural values – thus leading to appreciation by others of the culture’s richness; increased security in one’s own identity; the option to use the language in electronic media [59].

The Deaf have difficulties to acquire a writing system, be it of the oral language, or of the Sign Language [1] [4]. Writing systems serve as support for the modern, global society. They are used for literature, cultural preservation, information storage and retrieval, science, knowledge creation, communication among many others many vital societal functions [11]. Sign Languages share a commonality with other oral languages from minority and indigenous groups that have their own cultural and traditional means of maintaining folk language art forms. SignWriting, created by Sutton [4] is the most used writing system for Sign Language. There is very few written material in Sign Language, which
deprives the Deaf community of a major component of their culture, education and overall development. Exceptions can be found at [4]. It is not enough to present the Deaf with concepts in the oral language, and expect them to create concepts in their own culture [60].

Current computer editors, which aim at providing the Deaf with writing system support, fail to deliver, either because they lack usability and/or because they have inadequate approaches [14]. Firstly, they provide the user with a series of menus from which to choose the primitives of SignWriting – this approach renders the task of writing a sign a difficult and time-consuming process (e.g. SW-Edit [5]). Some systems require the Deaf to wear gloves and sensors – thus limiting their ability to utter properly in Sign Language as in Lu, Shark, Hall & Zeshan [6]. Other systems are a one-to-one glossary, with the input being in the oral language – a total dependency on the oral language and limited to the availability of the word on the database (e.g. Delegs-Editor [7]). Finally, they are translators – again, from the oral language – and require extensive knowledge of Computer Science (SWML [8]).

Computer vision is a field that has attempted to develop services based on Sign Languages, but mostly they concentrate on video work, and, to our knowledge, although there are several studies of hand writing recognition for many languages such as Japanese, Arabic, Chinese among others, there is still a long way to go for writing systems of Sign Language.

The challenge to provide tools for written Sign Language is an urgent, clear call for innovative approach, lest we are faced with an entire community with no written history. Memory dependent and non-memory dependent are two different manner of human existence, and the latter is considered to be the basis for modern society [11] [59].

Thus, the main goal of this research is to propose a new paradigm – that of using hand written character recognition of SignWriting, with a broader, Human-Computer Interaction perspective of the Deaf needs, in a natural, more direct writing way, through the use of a tablet screen and stylus. Simply put, the user would “draw” the primitives of SignWriting into the tablet using the pen, and computer vision hand writing recognition would then generate the appropriate sign from the handwritten input.

In order to achieve the proposed goal, Computer Vision requires a database with which to work. This paper presents an online database of handwritten SignWriting primitives collected using tablets and pen devices. Such database is to be used by the computer vision community to inform design of SignWriting systems. The database is available at (address omitted for blind review). Standard database allows the development, evaluation and comparison of different algorithms.

The approach presented recasts computer vision into the role of front runners in the noble task of developing computer services for real and effective tools for the writing needs of the Deaf; services that should be used to inform design of artifacts for social inclusion and cultural preservation.

The remainder of this paper further describes the plight of the Deaf, and their need for Sign Language and a writing system; briefly discusses SignWriting as a writing system of choice; shows some inadequacies of related work and, then, presents the online database.

2. Deaf issues, Sign Language

The lack of early Sign Language acquisition (the mother tongue of the Deaf) makes it difficult for Deaf children to learn basic concepts of daily life [9]. The learning of such basic daily life concepts should occur when the child recognizes patterns in the world and start to identify linguistic labels for them. Later, the child learns to ask questions in order to clarify doubts, and starts to form relations that alter their cognitive structures: Children begin to combine, compare, infer, deduce and extrapolate old and new knowledge, in a mental process that is mediated by social experiences and language [9].

This lack of mother tongue acquisition is detrimental to the intellectual development of Deaf children, and brings about severe consequences, such as the inability to perform daily tasks for the development of intelligent action; the inability to learn and plan; the inability to overcome impulsive behavior; the dependency on concrete, visual situations; difficulties to control herself and to socialize, among others [9] [10]. Thus deprived of intellectual development and use of language, members of the Deaf community face intellectual and social barriers of information access and knowledge creation, needed for identity formation and full citizenship [10]. Additionally, the Deaf grows into a reality where there is little written material in Sign Language [4].

Eighty five per cent (85%) of the world population uses some sort of Writing System, which serves as support and basis for the modern, global society [11] [59]. Writing systems are a sequence of symbols that represent a language. They serve many functions: they reproduce speech, thoughts, and abstract concepts among other language related
events [11]. Writing systems are more then “the painting of the voice” as Voltaire wanted: writing systems are a cultural representation of society, as used in literature; they are the utmost tool of human knowledge, necessary for science development; they play a major role in information dissemination in journalism; in many cultures, the calligraphy is an art [11] [12] [13].

As for writing systems for Sign Language, several authors claim its importance. Writing systems are more objective and substantial than the linguistic communication: it allows for abstract notions; and writing systems are rooted in the fundamental human need to store and retrieve information for communication with others over time and space [11] [12]. Writing systems are used to organize one’s lives, record dreams, discoveries and feelings [13]. Writing fulfills specific functions and meanings that require deliberate analytic actions needed to create an intentional structure; writing conveys more than ideas: it represents our way of seeing, feeling and interpreting the world [14].

The new intellectual technologies brought about by the computer should be better explored as managers of memory; through recording of social enunciation, and through writing systems, that allows humanity, via writing, to keep a more permanent history, less dependent of individual memory [15].

Writing systems are usually associated with the oral language, and, as such, there is a misconception about the possibilities and gains of the use of a writing system by the Deaf, who use Sign Language. Sign Language is a complete linguistic system, of visual-spatial manner. Thus, Sign Language requires a writing system that is compatible to its nature (i.e. a writing system that is capable of mapping the visual-spatial properties of the language that it proposes to represent).

The use of an adequate writing system for Sign Language helps the Deaf to develop an internal structure akin to her natural language, in a process that increases the linguistic and cognitive skills; such use enhances identity and Deaf culture [16].

Unfortunately, the Deaf community had their process of research, development and use of Sign Language and its writing system interrupted for over a hundred (100) years by the International Conference of Deaf Educators, whose delegates banned the use of Sign Language in Deaf education [1] [2] [4] [13] [14]. This lack of access to an adequate language and writing system deprived the Deaf of meaning construction and educational learning strategies. The use of the writing system from the oral language, of which the Deaf have little to no understanding, doesn’t aid the learning, memorization, association of knowledge, access to knowledge of other related areas [14]. The advantages that reading and writing could offer will exist only if the linguistic code used is naturally accessible – that is, a writing system of Sign Language [14].

There are co-existing proposed writing systems for Sign Language, of which the following are some examples: Mimographie notation by Bébian [17]; Stokoe notation [18]; Hamburg Notation System – HamNoSys by Hanke [19]; D’Sign system by Jouison [20]; François Neve notation [21]; and SignWriting [4]; some are restricted to the Brazilian Sign Language, such as Elis [22] and SEL [23]. The fact that there are many conflicting writing systems alone is, per se, a complicating factor. SignWriting is universal, and it is the most used writing system in Brazil and in the world [25], and, therefore, shall be the focus of this study.

3. Importance of a writing system for Sign Languages

Language is more than a way of communication [24]. Language includes a regulation function of thought [3]. [14] presents a literature review of some of the existing writing systems for transcription of signs, such as the notations from Stokoe, François Neve, HamNoSys and SignWriting. These notations are writing systems for signs, developed to facilitate the recording and registration of signs through graphical symbols.

SignWriting is the most used writing system for Sign Language [25]. It is universal (i.e., just like the Latin alphabet is used by many writing system, SignWriting is used by many different Sign Languages). SignWriting is based on a pictorial/ideographic representation system, whose organizing principle follows visual-spatial significant elements [4]. It is a system conceived to be used by Deaf people in their daily tasks. It serves the same purposes as other writing systems from oral languages: take notes, read and write books and newspaper, learning at school, write contracts, do research, create literature etc.), thus making it valuable in real practical use [4] [14].

Figure 1 presents some Signs in American Sign Language (ASL), and its written form in SignWriting, Stokoe’s notations and HamNoSys. The Signs are for the English words “What”, “Quote”, “Three”, “Bears” and “Goldilocks”.

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The incorporation of the writing system of the Sign Language (i.e. SignWriting) into the political-pedagogical projects developed in a bilingual context for the Deaf represent a paramount contribution to the dissemination of the Libras and of the Deaf culture. Such incorporation constitutes a mediating tool for Bilingual Literacy of the Deaf. Bilingual literacy, the adequate choice for Deaf education [24], is the resulting process of social practices of the use of the written form as a symbolic system [24]. Sign Language is to be acquired by the Deaf via a functional use of the language, where language assumes a character of real meaning: “Therefore, Literacy as effective appropriation is pleasurable, is leisure, is access to information, is communication, is a way to exercise citizenship in different social practices” [1:131].

From the point of view of the linguistic political planning, the use of the semiotic writing system legitimates the representation of the Deaf culture, as well as the identity ties, given the important role that the dissemination of a writing system takes on the standardization, lexical enhancement and overall literary and artistic accumulation [1] [59]. In such political and social scenario, a more natural use and dissemination of SignWriting creates the opportunity for a greater balance in power relations between the Sign Language and the oral language (Portuguese, in our case). Sign Languages increase in importance due to the historical role of writing systems in maintaining alive the memory of the language. This memory is achieved by the incorporation and recording of the collection of human knowledge. The information culture aims at the construction of a collective intelligence, which, among other processes, is achieved through language. The goal is to educate citizens in the storage, retrieval, evaluation and effective use of information to solve problems and make decisions [26]. The exclusion of the Deaf implicates in their non-participation in this construction of intelligence.

From the pedagogical point of view, the current discussion is related to the specificities of the alphabetization of the Deaf, and how the SignWriting should constitute a mediating element in the appropriation of the alphabetic writing system of the oral language [4] [14]. The learning of the oral language by the Deaf works with the premise that meaning attribution in writing follows from visual and symbolic processes, in which the use of Sign Language takes on a pivotal role. The written form of the second language can be achieve because the development of writing is independent from the oral language, given that it is a different system, both in structure and behavior [3].

However, to realize such premise, there is a need for educational processes that differ from the ones used in teaching the oral language as the maternal language (for non-Deaf children). The current methods do not scaffold the learning by the Deaf, and it takes approximately nine (9) years to alphabetize a Deaf child [23]. Alphabetization relies on the relations between phoneme and graphemes made by the native speakers, which cannot be achieved by the Deaf. Some studies about the specificities of the literacy process of the Deaf [1] [16] [24] [27] address such issue by proposing to forgo the domain of the relations letter-sound as a premise to access the writing system.

[1] [24] and others propose the use of Sign Language as a mediating symbolism in the learning of the written text, and the use of methodological processes from the teaching of a second language to foreigners to enable the insertion of the Deaf in literacy practices. To read without being “alphabetized” corresponds to the reality of subjects that possess a non-alphabetic language as the mother tongue, and said subjects master the writing systems of a second alphabetic language, even if they do not communicate orally through it [1]. In this sense, the direct visual aspect of SignWriting represents a mediator element that contributes to the development of the complex superior psychological functions (e.g. memory, abstraction, generalization, meta-language etc. [3]) of the Deaf children, in a manner that increases literacy.
Existing editors are detrimental to the teaching and use of SignWriting. Consider, if you will, a scenario where a Deaf is watching a class, and wants to take her own notes: such simple task would be time and effort consuming if she were to use such editors [4] [14].

The present research proposes a more natural way to enter text in SignWriting: hand-written character recognition of SignWriting using a tablet and a stylus. This is an innovative intermediary process in the acquisition of SignWriting. Such approach serves as mediation for the acquisition of both the writing system of the Sign Language and of the oral language. It allows for the establishment of new relations for knowledge creation and new forms of mental activities, cognitive development, historical vector of standardization and cultural support. The database presented is to inform design of systems that support this direct approach.

4. **SignWriting**: writing system for Sign Languages

Sign Languages are consisted of several parameters such as Hand Configuration, Contact (Location), Palm of Hand Orientation, Global and Local Movement and Non-Manual Expressions [18]. Linguists use such phonological parameters to describe a sign in Sign Language. Several computational models have been created to represent them [28]. Devised by Valerie Sutton [4] in the mid-70’s, SignWriting has been the most universally accepted and used writing system for Sign Languages around the world [13] [25]. The reader can find several learning materials for SignWriting [4] [13] [25].

According to International SignWriting Alphabet (ISWA) [29], there are 30 pictorial symbol groups. Each group contains 639 basic pictorial symbols. It is possible for each basic symbol to have 96 variations (up to 6 different fills and 16 rotations). Such combinations yield a total of 35,023 valid symbols. These numbers have increased with the ISWA 2010. A much longer time is therefore needed to select and combine symbols to input a single sign than to type a word. The few existing editors for SignWriting are not complete; they lack usability resources; they are not in SL (i.e. they are in the oral language), they use specific, sophisticated software interaction (e.g. many levels of menu to find a primitive) etc., all of which render them difficult to use, and they exclude the context of natural writing by the Deaf [13] [14] [22] [23].

SignWriting preserves the tridimensional characteristics of the Sign Language as it contemplates several representations for the phonological parameters, such as: Hand position and orientation; Types of Contacts; Hand Configuration; Finger Movements; Arm Movements and Pointing; Non-Manual Expression; Facial Expressions; Location of Symbols in the Head; Head Movement; Gaze orientation; Body Movement; Movement Dynamics, among others. Figure 2 shows a picture of a Hand Configuration in three orientations and its representation in SignWriting.

Hand Configuration is one of the basic SignWriting primitives for a hand configuration in three different orientations. Some of the symbols used by SignWriting are very iconic, which allows for a rapid association with the actual sign. The graphemes are presented simultaneously and sequentially, in a manner that best suit the nature of the Sign Language – a considerable difference when compared to other writing systems, which present the graphemes in linear form, in a pattern that follows the logic of the alphabetic writing of the oral languages.

![Figure 2 – Hand Configuration and the corresponding SignWriting. Source [4].](image)

5. **Automatic Sign Language recognition**

Albeit the several positive aspects related to accessibility and inclusion that the systematization and dissemination of a writing system in Sign Language would bring to the Deaf community, there are very few publications, and the informational tools in SignWriting are precarious. The editors for SignWriting can be thus classified: First we have the “drag and drop” paradigm [5] [30] in which the user is presented with a series of menus she must navigate to find the desired SignWriting primitive, drag it to the “writing” area, and repeat the navigation process.
until she finds all the primitives she wants (out of at least 35,000 primitives). Then, she is left with the task of trying to place the primitives on the correct location in an attempt to form the desired sign, with little to no usability and accessibility support.

Some editors require the user to wear cumbersome accessories, such as gloves, sensors etc. Others [7] are one-to-one translation from the oral language: this requires the Deaf to have extensive knowledge of the oral language (which is often not the case). Additionally, Sign Language is a completely different language, not dependent on the oral language, which makes such translation not viable. But the worst problem with the systems that follow such paradigm is that this approach allows for the writing of only the words that are present in the editor’s database (e.g. COFFEE may be in the database, but, if CAFETERIA isn’t already stored in the editor, then the user won’t be able to generate the SignWriting). Additionally, the surveyed editors did not allow the user to enter her own signs. Lastly, there are highly computational mark-up languages (SWML) [8], which are not adequate for general use. They would be more adequate for an actual translator: but that still will be more suited for non-Deaf people, who would be required to know before hand the entry to such translator (usually, the oral language, or some sort of video recognition).

Research in SL automatic recognition began in the late 80’s [31]. Since then, the field has seen innumerable studies in an attempt to recognize signs from video that were very successful in their mathematical, computational, and algorithmic approaches, but they have yet to deliver technological artifacts that promote effective interaction in situations of real use in SignWriting.

Most studies are for video Sign Language speech recognition [32] [33] [34]. Some studies are for gesture recognition [35]. Other studies are limited by a one-to-one lexical approach [36], by the use of only finger spelling, instead of real signs. [37] presents a comprehensive overview of available language resources for Sign Language processing and recognition.

[6] presents a system developed for recognition of hand movements. However, the proposed system uses video and glove, and the resulting use is that of mimicking the writing “in the air” to be captured by cameras. That would be the equivalent of requiring the user to wear a glove in her tongue for speech recognition systems. [38] proposes to recognize simulation of SignWriting with cameras, where the hand is tracked across the video using a computer vision algorithm. These approaches are far from the actual natural writing of SignWriting. Additionally, they may present problems with occlusion and loss of hand position, high computational cost and non-practical results.

As for handwriting character recognition, much work has been done on the recognition of Latin characters, covering both the cases of separated (hand printed) characters and cursive script. Several databases for English off-line handwriting recognition are summarized in [39] [40]. Some researches have been done on the task of recognizing other writing systems, such as the Arabic characters [41] [42] [43]; Indian characters [44]; Japanese Kanji [45]; Korean [46]; Chinese [47] [48]; Farsi [49]; [50] for Indonesian off-line character recognition used for the Latin script of the Indonesian language; Urdu (51) and so on. For other domains, we can cite bank cheques [52], postal address [53], and even shapes [54] among others.

Unfortunately, to our knowledge, there isn’t a database of handwritten SignWriting available for online recognition.

The handwriting systems discussed above assume that the handwritten word is already segmented into separated characters before recognition; the training and testing data consisted of only a small number of samples written by a single writer. They lack generalization, and present low recognition accuracies. Additionally, they are usually for off-line handwriting character recognition. Off-line character recognition works with static information that is acquired after all the text is written. Online character recognition works with information on the dynamics of the writing process as the text is being written.

[55] presents a database that uses electronic pen on digital tablet for online handwritten Tibetan character recognition. [56] presents a process for data acquisition, processing and feature extraction for Urdu characters, but fail to provide a public database with which the community can work to design the required software.

The literature review shows a picture that calls for challenging the traditional assumptions and perspectives that strongly frame the computer vision’s efforts. In Human-Computer Interaction, the human side is the most valuable, the most demanding and expensive part of the equation. Technology should serve humans, and not the other way around: humans should not have to “adapt” themselves in order to be able to use technology. Human-Computer Interaction field has long established the notion that the observation and understanding of what people do is no longer enough. Design and technology should be engaged in meeting societal challenges [57]. Conceptually, the picture shown by the related work depicts some (miss) conceptions on how the design
object is being framed; on how the stakeholders (users) are viewed; on the underlying assumptions being made in the user’s name; on the validity of such assumptions; on the lack of new ways to characterize the deaf problems, etc.

6. **SignWriting hand recognition**

Character recognition consists mostly of converting images of handwritten text to text in editable form. However, due to the **SignWriting**’s large set of characters, a more natural approach is necessary. There are several technologies that use touchscreen and stylus, and some quite accurate programs are available for input of geometric forms, numbers, mathematical symbols, English, Japanese, Chinese and Latin characters, among others.

But, to our knowledge, there is no support for **SignWriting**. Successful **SignWriting** handwritten character recognition is a complex process comprised of several steps that are interdependent. There is a need for a standard database of images to inform research in handwritten **SignWriting** text recognition. Such database should be used in the development, evaluation, and comparison of different, specific algorithms [40].

Most existing handwriting recognition algorithms can not be directly use for **SignWriting** recognition; for example, the recognition of Japanese writing is made easier because the writing in Japanese follows a prescribed order in which the word should be written. **SignWriting** does not provide such facilitator.

This research advances the state of the art by proposing a new **SignWriting** paradigm – one in which the user writes in a tablet with touch-screen and a stylus. The first step to achieve such goal is to generate corpus with which computer handwritten recognition should work, focus of this research.

The database presented is an ongoing project: it is our goal to make it available, so that others can enhance it by adding source material, as well as use it to create specific handwriting recognition algorithms. Data was collected assuming that handwritten varies due to knowledge of **SignWriting**, technology, age, sex and different date/time.

In its current form, it contains written material from 37 instances of the 118 hand configurations for the Brazilian Sign Language [13]. That is: each subject wrote the 118 primitives on a touch screen with stylus tablet. Each subject used the data collecting system at least twice. Figure 3 presents a print screen of the data collecting system. As can be seen, the system presents the symbol, and provides a free area for the user to reproduce such symbol.

![Data collecting system.](image)

Figure 3 – Data collecting system.

The subject can erase and correct her writing, and save when she is done. Figure 4 presents a sample of the data collected.

![Sample of the collected primitives.](image)

Figure 4 – Sample of the collected primitives.

Table 1 presents information about the 8 Deaf subjects, who knew **SignWriting**.

<table>
<thead>
<tr>
<th>Initials</th>
<th>Gender</th>
<th>Age</th>
<th># of Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVV</td>
<td>Female</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>STT</td>
<td>Female</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>NC</td>
<td>Female</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>LS</td>
<td>Female</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>AMF</td>
<td>Female</td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>CMD</td>
<td>Female</td>
<td>35</td>
<td>2</td>
</tr>
<tr>
<td>BPMS</td>
<td>Female</td>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>FHP</td>
<td>Male</td>
<td>34</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 2 presents information about non-Deaf subjects who did not know **SignWriting**.

Table 2 – Non-Deaf subject information.

Table 1 – Deaf subject information.
Table 2 – Non-Deaf subject information.

<table>
<thead>
<tr>
<th>Initials</th>
<th>Gender</th>
<th>Age</th>
<th># of Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRK</td>
<td>Male</td>
<td>08</td>
<td>1</td>
</tr>
<tr>
<td>BYJ</td>
<td>Female</td>
<td>08</td>
<td>1</td>
</tr>
<tr>
<td>RF</td>
<td>Male</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>AFJ</td>
<td>Male</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>DD</td>
<td>Female</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>CS</td>
<td>Female</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>VHS</td>
<td>Male</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>DS</td>
<td>Male</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>NJS</td>
<td>Female</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>AW</td>
<td>Female</td>
<td>45</td>
<td>3</td>
</tr>
<tr>
<td>CG</td>
<td>Male</td>
<td>42</td>
<td>3</td>
</tr>
</tbody>
</table>

Both AMF and AW are left-handed. Figure 5 illustrates the use of the tablet to write in SignWriting.

The shape of a character varies from person to person, and for the same person, from time of collection to the next. Writers provide the samples in the writing area in successively manner, with no constraints regarding the quality of the drawing.

The choice to start working with hand configuration was based on the fact that most signs have at least one hand configuration. The sample includes various instances of each group of the SignWriting hand configuration.

During the collection of data, the subjects volunteered some inputs that validated the proposal. These inputs are summarized here as per the categories proposed by [58]: Response: The Deaf subjects immediately demonstrated their approval of the new paradigm. Non-Deaf subjects were happy to find out that Sign Languages have a writing system. Motivation: The subjects expressed gladness to be able to collaborate with the research. Reflection: Non-Deaf subjects constantly inquired about the actual hand configuration, and asked for examples of a sign using the hand configuration. Deaf subjects questioned each and every hand configuration, exemplifying with signs. In one instance, the Deaf said that a specific hand configuration did not exist, because they were not able to find a sign using it. The researchers went back to [13], and found out that said hand configuration is both a hand configuration, and a sign for network MODEM. As it turned out, the questioning resulted in the Deaf learning a new sign.

10. Discussions

Not every language has a writing system, but, historically, all languages that use some sort of writing system are richer: users of writing systems are less dependent on oral history. A writing system for Sign Languages contributes for the Deaf community overall memory, literature, scientific knowledge creation, note taking, communication among others. Existing editors for Sign Language are inadequate.

This position paper proposes a more natural way to use one of the Sign Language writing system: that of writing directly on a device. The use of the proposed paradigm empowers members of the Deaf community with tools to appropriate their written system: in order to preserve their culture, language, history, knowledge creation, and literature, among others. Specially, it provides the Deaf with means to become less dependent of the Sign Language utterances only.

It is all belief that researchers will find this new paradigm worth the while. The database will be a useful tool in their work on SignWriting recognition.

This ongoing research is already working on: enhancing the database with more collections; enhancing the database with other categories of SignWriting, such as primitives for movement, location among other parameters of Sign Languages. The research group is also working on the design of a text editor for SignWriting. Most importantly, the group is working on devising algorithms to enable hand written recognition.

11. References