Special Education: LIBRAS and LFS, an Interactive Translator for Brazilians and French

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Abstract

A new social conscience is created, which will be used by a net society, at local and global levels, crossing both informatics and education contexts. So, this work proposes the construction of a tool for communication between listeners and speakers through the Brazilian Sign Language (LIBRAS) and the French Sign Language (LFS), making a simultaneous translation between the Brazilian written language and the French written language integrated through a web application, with the aid of the recognition of signals by techniques of image recognition and use of webservices. In addition, it raises a bibliography of the struggle of disabled people, the importance of non-verbal communication in human life, as well as an analysis of several translators available in the electronic mean, raising their strengths and weaknesses by comparing them in standard color, structure and navigation used. At the end of the study, a general evaluation is carried out on the application of a questionnaire to the users and a case study with TRADUZ.
Keywords: Communication; Image Recognition; Sign; Translation.

1. Introduction

According to Teixeira (2012) A new social conscience is created, which will be used by a net society, at local and global levels, crossing both informatics and education contexts.

Increasingly People with Disabilities (PwD) have been fighting for equal rights and against prejudice. In the same context, there are the hearing impaired, who have been seeking for technologies to facilitate communication and social interaction.

Some tools such as, dictionaries and translators are available in the electronic mean seeking to meet their needs as the growth of the population of disabled people brings motivation to academics and scientific studies, in order to provide society a fairer, more dynamic and facilitated interaction.

However, PwD have been fighting for their rights and for a fairer society. Hegardless, in the evolution of social relations, such people have already been treated as invalid, disabled, exceptional, in Brazil, PPNEs, PNEs and at the dawn of the 21st century assume the designation of Disabled Persons - PwD (NUNES et al., 2008).

A demonstration of the significant increase in the teaching of students with special needs was recently presented by Bari et al. (2016) “The study found that teachers accept the implementation of early intervention programs in preschool special education, but they agreed to state early intervention aspect should be included in the curriculum of the National Preschool Special Education as a guide or reference teachers carry out early intervention”.

Therefore, to assist a PwD, Assistive Technology also known as Technical Assistance (TA), a relatively new term, is used to identify the features and services that contribute for providing or expanding functional abilities of PwD or with reduced mobility with the purpose of promoting inclusion and independence.

Among the TA resources, there are those that help in the teaching-learning process, allowing not only inclusion but better learning and interaction with other individuals. According to Schirmer et al. (2007), TA should be understood as the "user's resource" and not as a "professional’s resource" or of a specific field of performance. This characteristic differentiates TA from other technologies such as educational technology.

In this aspect, the present work aims to construct a communication mechanism so that speakers, listeners, and hearing with disabilities can communicate using the Brazilian (LIBRAS) and French (LFS) sign languages through an application that interprets signals using Recognition of images and simultaneous translations between written language and sign language, at the end the results of the evaluation by the users will be exposed.

2. Theoretical Reference

2.1 PwD and the Importance of Signal Translation Tools

It is no new that people with disabilities fight for their rights and for a more just society. Backed by law, they began to grow into a more conscious society with a view of equality.

The development of computer translation tools, as well as easy-to-access dictionaries available on the web seeks social integration and communication between auditory PwD and speakers from different countries, making dialogue between them favored by the advent of technology and globalization of the current world, thus contributing to the knowledge and strengthening of the bonds between these individuals (SILVA, 2011).

Thus, Martins et al. (2016) affirms that in the process of social inclusion it is praiseworthy to ensure the development of activities that motivate and encourage PwD to interact, making them less exclusionary and providing them more opportunities to access the goods and services they need.

Second Guimarães, Aquino & Fernandes (2017) "Secco & Silva (2009) present an environment in Libras, based on problem-solving strategies, to teach Libras: but it requires that the learner already know Libras (a strange contradiction)". However, a proposal of Secco & Silva (2009) presented elements of a primary work, and this work continues as future work, then any reference to traditional past work is updated by this present article.

Therefore, the proposal of this work seeks not only the growth of possibilities between communication of deaf people of Brazil (BR) and France (FR), but also the social integration between speakers and hearing PwD of these countries, providing an application where they will be able to communicate without the need of searching for other means or tools that are difficult to access. This tool proposes in its varied applications to bring together advanced computing and web dynamism to provide a high quality content and entertainment translator for both deaf and speakers.

2.2 Related Works: Dictionaries Available on the Market

In this section, some translators that are available in the electronic mean are presented, searched through the WebPages: Google, Bing and Cadê for the specific terms to the subject: Dictionnaire de la Langue des Signes Française for translators in French and Tradutor da Língua Brasileira de Sinais for translators in Portuguese.

In addition, the choice of dictionaries was based on the prioritization of tools that were linked in some way to a government institution, association or representative body of the PwD in the respective country. Because these bodies usually provide dictionaries with a lot of information and particularities of each country that are useful for building a robust tool.

2.2.1 LSF Sur Le Web

The LSF Sur Le Web dictionary (2003), highlighted among the various dictionaries available to the society, was created by the DESS - Sensory Technologies and Physical Deficiency, from University of Paris. Its goal is to give everyone easy access to PwD, giving them the opportunity to consult hundreds of signals, translated from French to LFS.

Figure 1. LSF Sur Le Web Dictionary.

LSF Sur Le Web Dictionary its a dictionary that allows you to watch videos in LFS.

As for the colors, as shown in Figure 1, the LSF Sur Le Web dictionary the website does not have a good standard, as there is predominance of black color, which refers to sadness, anguish and renunciation (ROYS, 2010). In addition, there is no good design pattern, no visibility, conceptual model and feedback. However, it presents affordances and good mapping.

2.2.2 Dico Complet LSF

Figure 2 presents Dico Complet LSF (2010), which does not have a reference formed about its organization and/or creator, being therefore only mentioned here its aesthetic characteristics of interface and ergonomics, as well as the amount of words of the translator and the amount of signals, it has about 1784 videos that translate from French to LSF.

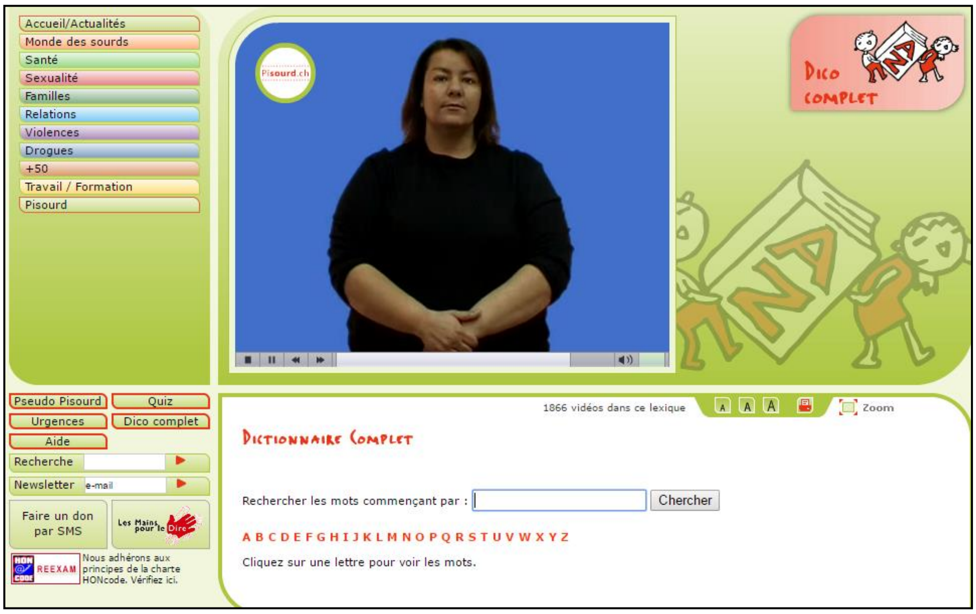


Figure 2. Dico Complet LSF Dictionary.

Dico Complet LSF Dictionary its a dictionary that allows you to watch videos in LFS.

It presents appropriate colors with light tones conveying tranquility, security and peace to the user, as stated in the study of color psychodynamics. The good use of the mapping allows the translation of French to LFS through word selection.

2.2.3 Web LSF Lexique

The LSF Web Lexique dictionary (2010), Figure 3, was created by four LFS professors from the National Institute of Deaf and Youth of the Ministry of Health and Solidarity of France. Professors support teaching of LFS for students and professionals who work with external audiences and who wish to learn sign language. They are also responsible for the dissemination of LFS news in intraschool life (educational activities, etc.) and have extra regional concerns from France the rest of the world.

Figure 3. Web LSF Lexique Dictionary.

Web LSF Lexique Dictionary its a dictionary that allows you to watch videos in LFS.

LSF Lexique Web features attractive shades with stimulating colors that bring peace, tenderness and user security. The website features three research themes: alphabetical order, by word, and by hand geometry, expressed in accessible standards for children, young people and adults.

2.2.4 VLibras

The result of a partnership between the Ministry of Planning, Development and Management (MP) and the Federal University of Paraíba (UFPB), VLibras, Figure 4, consists of a set of open source computational tools, responsible for translating digital content, (text, audio and video) for the Brazilian Sign Language (LIBRAS), making computers, mobile devices, and web platforms accessible to deaf people (VLIBRAS, 2016).

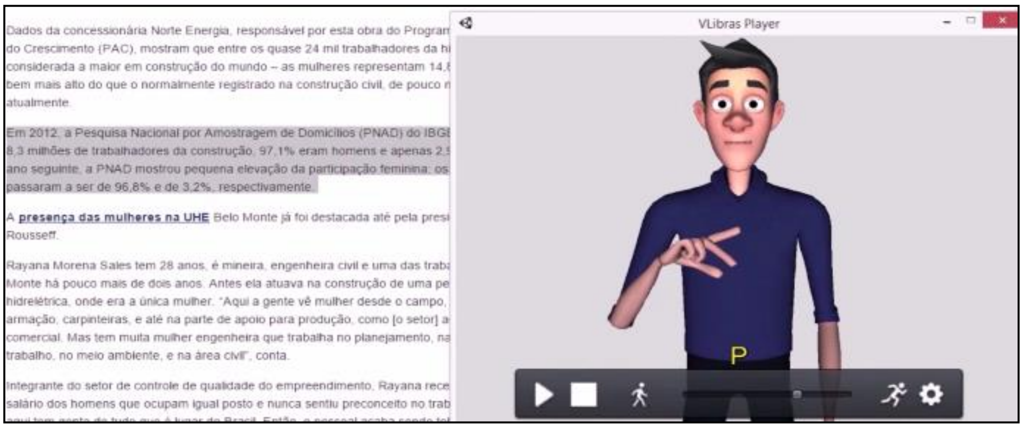


Figure 4. VLibras Suite.

VLibras its a dictionary that allows you to watch videos in LIBRAS.

VLibras is a suite of tools used in automatic translation from Portuguese into Brazilian Sign Language.

You can use these tools on both computer desktop and smartphones and tablets, available for Android and iOS (VLIBRAS, 2016). It is ergonomic and has good usability and also features soft colors, which conveys peace and tranquility during its use.

It is worth mentioning that there are several projects with the visibility of VLIBRAS, as the translator created by UDESC/CEAD - State University of Santa Catarina - Distance Education Center, in 2002 (inactive), which had a standard search for words in Portuguese, as well as VLIBRAS, the video corresponding to the selected word translating Portuguese to LIBRAS through the selections of words or excerpts.

2.2.5 VLibras

Among the sign language dictionaries stands out the Digital Dictionary of the Brazilian Sign Language, created by the National Institute of Education of the Deaf (INES, 2010), presenting an easy-to-use and adaptable structure for people of all ages.

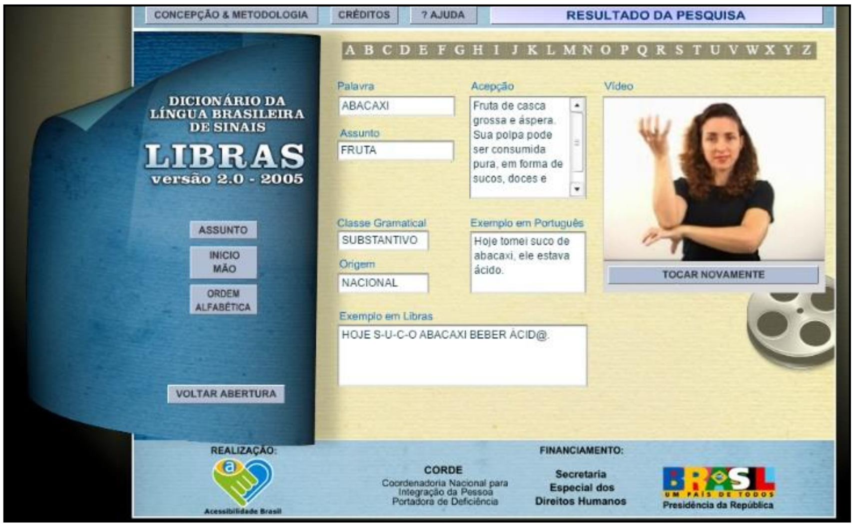


Figure 5. Dictionary of the Brazilian Sign Language.
Digital Dictionary of the Brazilian Sign Language its a dictionary that allows you to watch videos in LIBRAS.

The DDLBS simultaneously translates Portuguese/Brazilian Sign Language. It contains illustration, movement description, grammatical class, region, hand configuration and acceptance. As can be seen in Figure 5, it presents light colors, which refer to peace and good mood of the users.

3. TRADUZ (Proposal)

TRADUZ proposal is structured as shown in Figure 6, where speakers who know Portuguese, French, Brazilian Sign Language or LFS will be able to communicate with hearing PwD that know one of these languages and vice versa. For example, a speaker who knows French can communicate with a hearing PwD that knows LFS.

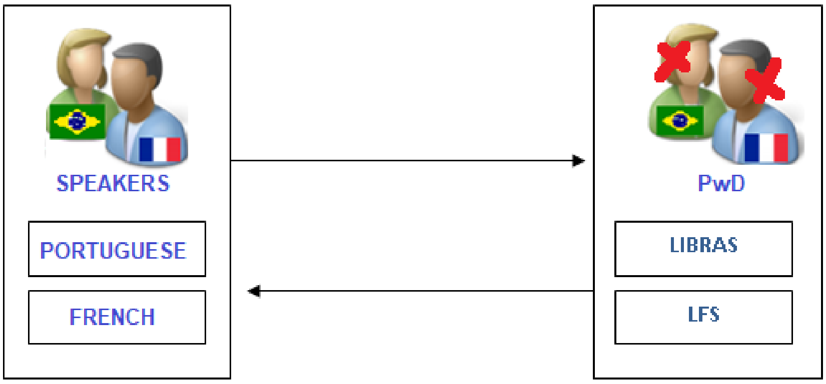


Figure 6. TRADUZ stakeholders: possibility of communication.
Model of communication between speakers and deaf people in Brazil and France.

3.1 Methodology

During the course of this work bibliographic surveys were carried out on translators of the Brazilian Sign Language (LIBRAS) and the French Language of Signals (LFS), with comparative analysis; A tool layout based on the results of the comparative analysis of LIBRAS and LFS translators was constructed in order to fill all unmet needs in the analysis results; Communication between webservices and the application of the translator were carried out; Finally, algorithms and image recognition techniques were used to perform the recognition of signals made through a camera.

TRADUZ has two basic functionalities. The first one, it is able to translate a written word (typed) into a sign whether it is in French or in Portuguese. And the second one, it uses a camera connected to the computer to perform LIBRAS signals and translate them to Portuguese, French and LFS.

One of the features of the proposed translator is composed of webservices, where when typing a word in the search field, as shown in Figure 7, the translator sends this word to Google Translator in a hidden way (without the user noticing) and depending on the language one is browsing (Portuguese or French), Google API returns to the text translation. Consequently, the video signal for this word will be searched in one of the dictionaries selected for analysis in section 2.

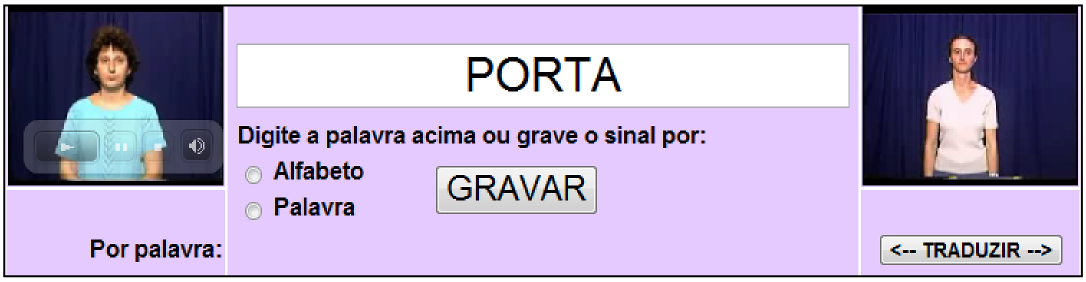


Figure 7. Example of TRADUZ functionality.
Explanatory area for insertion of text (speakers portugueses and french) and for recording of symbols (deaf, portugueses and french).

3.2 Methodology

The system architecture consists of a communication between the user, an interface (browser) and an API2 from Google Translate. The translation process can be seen in Figure 8.

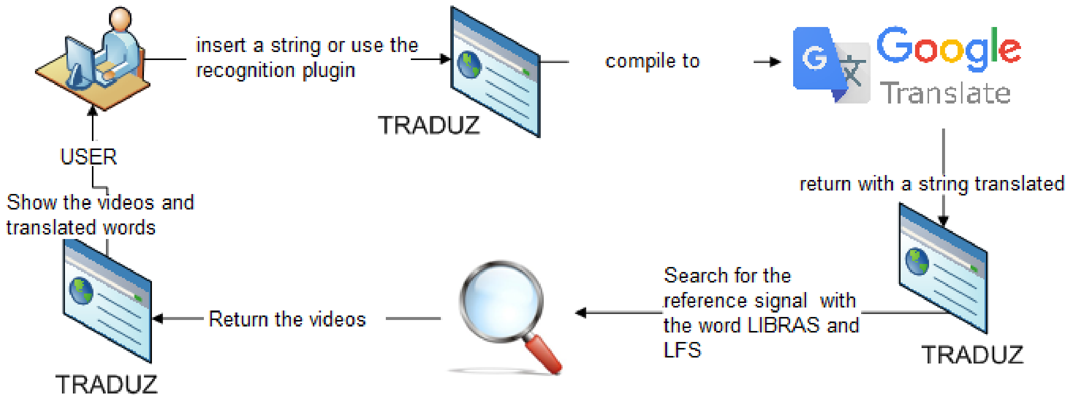


Figure 8. Translation architecture.
Working model of the TRADUZ tool.

3.3 Signal Recognition Techniques: Ciratefi

Complementing the translation process it was chosen the CIRATEFI technique for the signal recognitions by images.

The CIRATEFI technique was developed by Kim and Araújo (2007) and optimized by Nobre and Kim (2009), researchers from the University of São Paulo. The authors point out that current algorithms for image recognition require high computational power and sophisticated hardware for better performance, such as the Field-Programmable Gate Array (FPGA) that allows the programmer to access and change hardware factory settings using FPGA.

The word CIRATEFI refers to three filters CIFI, RAFI and TEFI, and according to Nobre (2009):

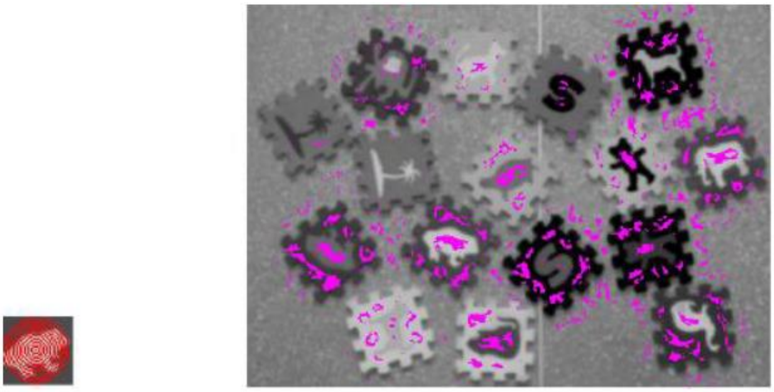
“The first two filters, Cifi and Rafi are the slowest. The last filter is about 7 times faster than the first filter and 13 times faster than the second filter. In this sense, this work is focused on the resolution of the first two filters in hardware. On the other hand, the third filter would integrate a complete solution based on coprocessing FPGAs and conventional processing. "(NOBLE, 2009).

3.3.1 Cifi Filter (Circular Sampling Filter)

Cifi filter (circular sampling filter) calculates the average of the grayscale pixels of the A and Q images and, through these circles, finds the exact locations of the pixels that are close to this average situated at a defined distance ‘r’. According to Nobre (2009), to extract the attributes of the image to be analyzed Q, a 3D image is created where k represents the gray level of the image and Cis (x,y,r) the circular sampling, as expressed in Equation 1.

$$C_a\,[x, y, k] = Cis_A\,(x, y, r_k), 0 \leq k \ < A\ e\ (x, y) \in domain\ Q$$

If the correlation between pixel (x, y) is greater than t (acceptance limit) the pixel is characterized as a first phase candidate (SILVA, 2011). In Figure 9 it is possible to visualize the result of the Cifi filter (b) and the circular projections executed on the standard image A (a).



(a) Circular projection on A (b) Result from image of application of CIF filter

Figure 9. Cifi filter result indicating in magenta the candidate pixels in the first phase.
Image processing filter.

3.3.2 Rafi filter (Radial Sampling Filter)

The Rafi (radial sampling filter) reevaluates the first phase pixels by promoting the probable pixels in different rotations for the second phase and discarding the others.

Thus, the standard image A depicted radially in Figure 10 (a) can be applied over the image to be analyzed Q, where the gray level average of the pixels located on the radial lines will define the pattern for correlation between the first phase pixels, that applying to the image A at several angles, the pixels of the radial lines will be compared with the pixels of the image Q and thus obtain the probable angle of rotation that best positions the match (ARAÚJO, 2009). The probable rotation angle for each pixel can be calculated from Equation 2.

$$RasAng_{A,Q}(x,y) = ARGMAX_{j=0}^{m-1}[\left|Corr\left(R_A[x,y], cshift_j(R_q)\right)\right|]$$

ARGMAX is the operator that returns the displacement j related to the angle of rotation that maximizes Coor (correlation proposed by the author).

The complete calculations on how to obtain the best angle for each pixel candidate of the second phase to a better match can be found in Araújo (2009), as shown in Figure 10.

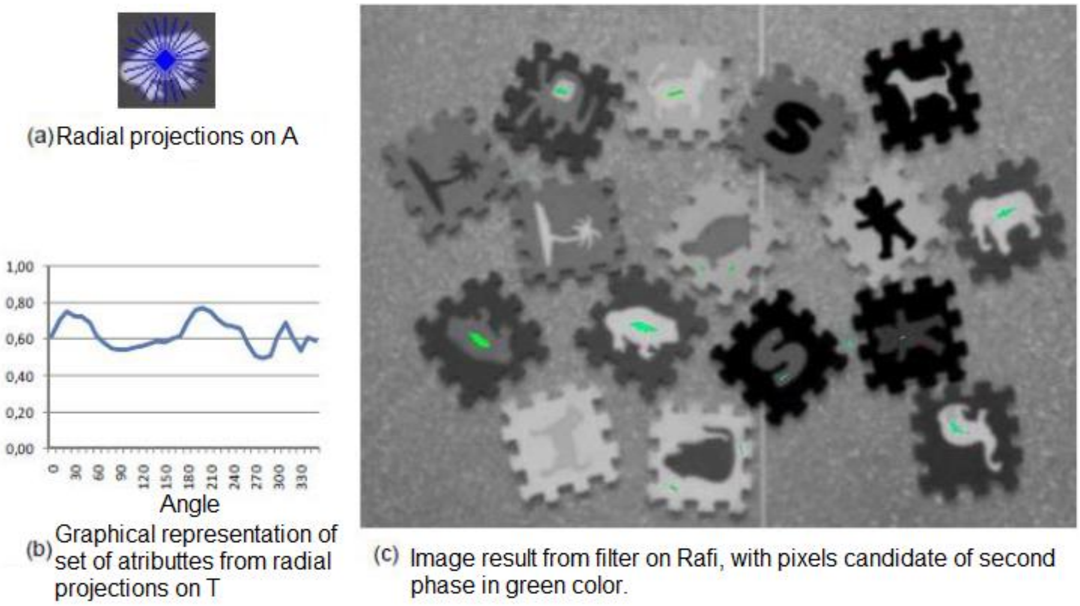


Figure 10. Rafi filter result.
Image processing filter.

3.3.3 Tefi Filter (Template Matching Filter)

The third filter, called the Tefi filter, is a conventional template matching algorithm, invariant to brightness and contrast, which is applied to the candidate pixels of the second phase using the scales and angles determined respectively by Cifi and Rafi (NOBRE, 2009). Thus the template matching by brute force is accomplished.

Therefore, given (x, y) a second phase pixel with probable scale i = CisPSA, Q (x, y) and probable angle j = RasAngA, Q (x, y), then Tefi computes the correlation of A on the scale, angle and subimage of Q around the pixel (x, y). If the absolute value of the correlation is above the limit of acceptance delimited, it is considered that there is an instance of the standard image A in the image to be analyzed Q with the center of the distance from A in (x, y) (ARAÚJO, 2009). The example of a Tefi filter is shown in Figure 11.

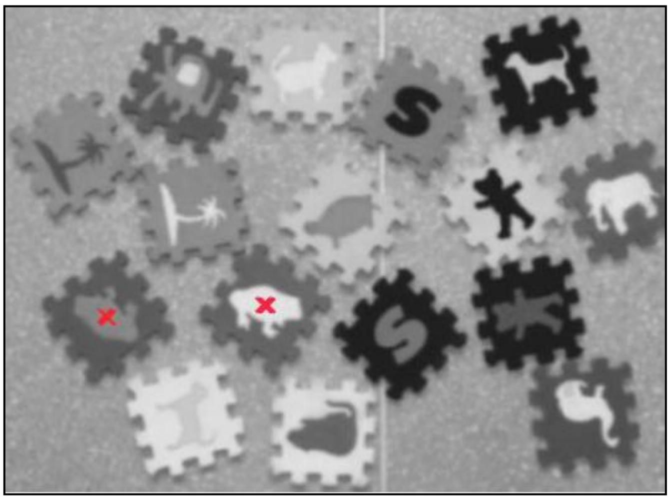


Figure 11. Tefi filter result indicating the located pixels.
Image processing filter.

3.3 Use of CIRATEFI for signal recognition in TRADUZ

The signal recognition functionality using image recognition techniques was added to TRADUZ due to the need for greater human-computer interaction, providing something unprecedented among computational translators and following W3C principles and standards.

With this, the structure was set up in order to make TRADUZ dynamic and in the web environment, which makes it difficult and often compromises in a considerable level the image recognition process. However, application optimization techniques have been developed to reduce the lock between the user and the processing server.

When finding the searched object, the CIRATEFI algorithm creates an "output image" that has a red color circumference, indicating the location of the found object. If it does not find the object, the algorithm generates the identical image to the image that it was requested to compare (KIM; ARAÚJO, 2007).

3.4 Capturing signal for recognition in TRADUZ

Capture of alphabetic signals from A to Z, as well as words, is performed using a platform that gains access to privileges to use the user's camera in the web environment.

Thus, as shown in Figure 12, the user clicks GRAVAR (record), when the signal capture begins, and from this, when the user clicks the stop button, the captures of the camera images will be closed. Afterwards the user clicks on RECONHECER (recognize) and from there Ciratefi takes action.

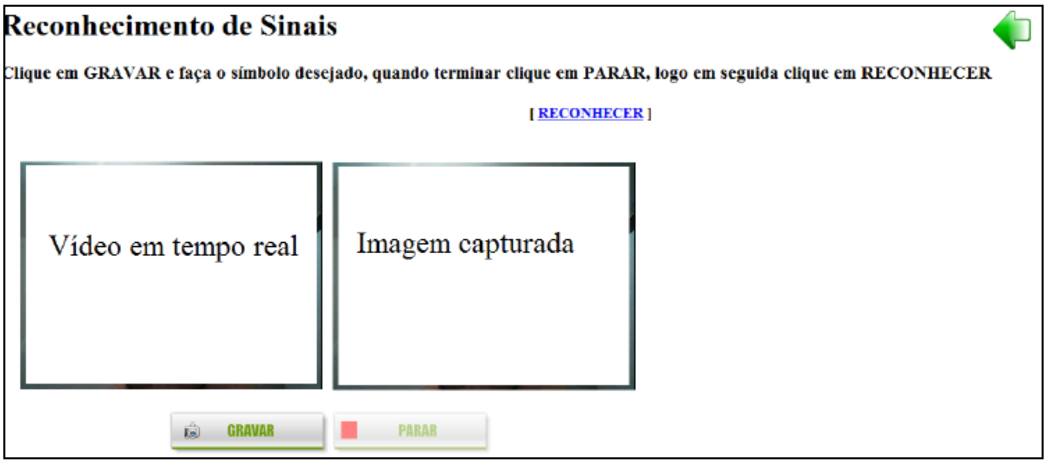


Figure 12. Signal capture screen using camera.
Capturing signal for recognition.

In this perspective, tests performed with the algorithm revealed that it works effectively, where comparing the technique to conventional template matching algorithm, CIRATEFI is about four hundred and seventeen times faster (KIM; ARAÚJO, 2007).

Therefore, Ciratefi will use the alphabet images from A to Z according to the user's choice or, as shown in Figure 13, the user chooses the option to record the signal by word; an image bank with words will be used to compare user images that were preconfigured with a 1.3 Megapixel webcam.

Figure 13. TRADUZ main screen in Brazilian layout.
Platform TRADUZ in Brazilian layout.

It is possible to observe in Figure 14 an example after the capture of a signal generated by the user choosing the option of recognition by letter.

Figure 14. Letter A (LIBRAS) was recognized by Ciratefi in 0.012 minutes.
Recognition of signal in TRADUZ.

3.5 Capturing signal for recognition in TRADUZ

After image capture by the previously mentioned application, an algorithm (Figure 15) was generated to reduce the size of the image and turn it into gray scales, in order to speed up the recognition process of the sign in the image and decrease the response time from server to user.

The resizing was performed to speed up the recognition and interruption process by recognition in the algorithm that starts Ciratefi. On the other hand, gray scaling strengthens the robustness and simplicity for recognition using Ciratefi.

This technique does not have an open source code, not even an output configuration file with information about when it found the object searched or if it did not; It only provides an executable followed by configuration files.

Thereby, the method implemented to analyze when the researched object was found was to perform a mapping and pixel location of the red color, analyzing in the grayscale image the colors red, green, and blue, where RED> 130, GREEN <100 and BLUE <100 on the RGB scale. Thus, by scanning the image, the first pixel from left to right, from top to bottom of the output image is analyzed and, upon being found, the application stops searching and goes to the next letter to be analyzed.

It is observed in Figure 15 the representation of the function in PHP language that verifies if the pixel has red color shades or not.

```php
<?php
function temVermelho($img,$b,$a){
    $rgb = imagecolorat ($img,$b,$a);
    $r = ($rgb >> 16) & 0xFF;
    $g = ($rgb >> 8) & 0xFF;
    $b = $rgb & 0xFF;
    if ($r>130 && $g<100 && $b<100)  return true;
}
?>
```

Figure 15. Function for checking the red pixel in an image.
Recognition of red color for identify automatically the signal.

From this the secondary algorithm stores the recognized letters while controls the Ciratefi flow.
In Figure 16 TRADUZ flow can be analyzed for the recognition of signals with optimization.

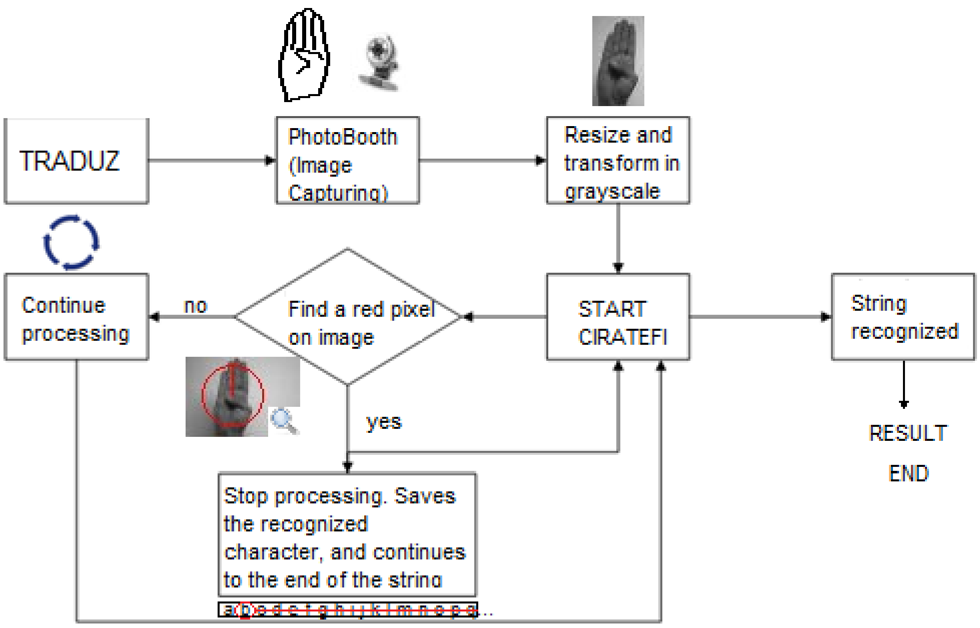


Figure 16. Signal recognition flowchart using image recognition techniques.
Flow of TRADUZ.

4. Results

4.1 TRADUZ Avaluation

Two types of evaluation were performed: the first was to measure the accuracy of the Ciratefi algorithm. For this purpose, the degree of correctness was measured when a user represented the signals made before a camera. The second was to verify the usability criteria according to the Human Machine Interface standards. Finally, questionnaires with information about the use of the tool were applied to evaluate and obtain clear results regarding to the developed translator tool.
TRADUZ evaluation was performed to verify the degree of accuracy when applied to the image recognition technique in signals made in front of a camera by a user, and also the usability, navigability and ease of use of the tool were verified through a questionnaire.
In addition, a case study was carried out to verify the level of agreement with the recognition of signals by images and a questionnaire was applied by the author to the TRADUZ users in the city of Serra Talhada - PE and Triunfo – PE, cities located on northeast Brazil, in 2016.

4.2 Case Study

For the case study with words, a base was generated with ten random words, each of them having X frames according to their degree of need.
This assessment was made by the author using the operating system Windows Seven on an Intel Core i3 CPU with 2GB of RAM and a 1.3 megapixel camera with a solid color T-shirt.
After processing each word, one can analyze how many images were correctly recognized by the Ciratefi algorithm, with the support of pixel map methods, reduction and optimization of the recognition process. It was also tested the recognition based on the alphabet from A to Z.

4.3 Results of TRADUZ Application

From the users who were undergone to the use of TRADUZ, 54.54% had special hearing needs and the rest of them were Portuguese speakers. In addition to that 37% of them had higher education degree (or were current graduating), 36% elementary education, and 28% high school.
According to users, the colors used in TRADUZ are in accordance with their satisfaction, once 100% said they liked the colors of the tool. Similarly, TRADUZ is easy to use, once 100% of users said there was no problem using the translator.
Subsequently with the results of the evaluation it is noticed that 98% of the words were recognized and found correctly and only 2% were not, being the words selected randomly by the users and inserted in TRADUZ.
From the questionnaire applied, it was possible to verify if the user has difficulty navigating TRADUZ, and 100% of the users reported that they did not have difficulty navigating it, besides 9% of users reported that they could not communicate with a PwD from France, and 91% reported that they succeeded.

Moreover, navigation in TRADUZ was also evaluated without the need for texts. Of the evaluated ones, 100% answered that they would be able to navigate with no problems.
At the same time, an open-ended question about the tool's strengths and weaknesses was made available in the questionnaire, thus realizing that users were satisfied, specifically the hearing PwD who wrote in LIBRAS their emotions expressed as happiness and joy, showing the importance of the dictionary availability to the community.

4.4 Comparative Analysis and Used Methods

The methodologies used as basis for this study are: image recognition, bibliographical literature review, color psychodynamics, and man-machine interface ergonomics studies, in order to extract as much of the existing applications as possible, these methodologies will be presented below.
Thus, studies of ergonomics and man-machine interface will serve to improve the application and make it more dynamic to the user.
In addition, the structural principles, content and ease of navigation of the selected dictionaries were analyzed with the purpose of extracting the best functionalities and qualities of each one, applying some methodologies that served as a basis for the construction of TRADUZ.
Among these methodologies, were used the standards Table 1 of the W3C - WWW CONSORTIUM, an international organization that studies and disseminates web design patterns, as can be seen in the Web Content Accessibility Recommendations (WCAG) 2.0 released in 2008 (W3C, 2010).

Table 1. Summary of key W3C recommendations.

PRINCIPLE	RECOMMENDATION	SPECIFICATIONS
PRINCIPLE 1: View - Information and user interface components must be presented to users in a way that they can perceive;	RECOMMENDATION - Alternatives in Text: Provide alternatives in text for any non-text content, thus allowing for it to be changed to other forms more suited to the individual's need, such as extended print, Braille, speech, symbols or Simpler language.	Sensorial: If the purpose of the content is not textual, essentially creating something sensory specific, then the alternatives in text must provide at least a descriptive identification of non-textual content.
PRINCIPLE 2: Operable - The user interface and navigation components must be operable;	Recommendation - Keyboard Accessible: Make all functionality available from the keyboard. Recommendation - Navigable: Provide ways to help users navigate, find content, and determine where they are.	
PRINCIPLE 3: Understandable - The information and operation of the user interface must be understandable;	Recommendation - Predictable: Make web pages appear and work predictably.	
PRINCIPLE 4 - Robust - Content must be robust enough to be interpreted concisely by a variety of user agents, including assistive technologies.	Recommendation - Compatible: Maximize compatibility with current and future user agents, including assistive technologies.	In content implemented using markup languages, elements have start and end tags, elements are embedded according to their specifications, elements can not contain duplicate attributes, and all IDs are unique except when the specifications allow for these characteristics.

Principles to be considered by PwD tools.

Finally, the study of color psychodynamics was used as a method to analyze the dictionaries, which is to analyze the psychological sensations that colors cause to the human being (FREITAS, 2007).

4.4.1 Results from Analysis

Based on the analysis of the dictionaries through the applied methodology, a form was created, Figure 17, that demonstrates a comparison between the dictionaries with their advantages and disadvantages.

ADVANTAGES / TRANSLATORS	LSF SUR LE WEB	DICO COMPLET LSF	WEB LSF LEXIQUE	VLIBRAS	TRADUZ (PROPOSAL)
Diversity of audience?	X	X	X	S	S
Uses W3C standards?	X	X	X	X	S
Content suitable for the target audience?	S	S	S	S	S
Proper navigation?	X	X	X	X	S
Translate to another language?	X	X	X	X	S
Suitable colors?	S	S	X	S	S
Diversity of searches?	X	X	X	S	S
Location mapping?	S	X	X	X	S
Has good visibility?	S	S	S	S	S
Presents Affordances?	X	X	X	X	S
Presents *Feedback*?	S	S	S	S	S
It is a good conceptual model?	X	X	X	X	S

Figure 17. Comparative analysis between translators.
Results of reviews of the available dictionaries.

As can be seen, most dictionaries do not follow the W3C standards or have a mechanism by which an individual who does not have knowledge of written languages (Portuguese and French) can navigate the dictionary, since most links, text input fields, or even headings and footnotes do not have an explanation in sign languages. For navigation improvement, Silva et al. (2017) suggests the following mechanisms:

1. Virtual Keyboard: creating a virtual keyboard that allows user which has as his/her native language LIBRAS / LFS and / or Portuguese / French, to choose in their language the composition of the letters (symbols) of a word, thus facilitating access by non-listeners who do not know the written language;
2. Videotext: explaining what each text contained in the site means, but being careful not to pollute the virtual environment;
3. Images: using images that resemble the action that the user must perform, or that the user executed;
4. Signal Recognition: Using image recognition algorithms to analyze the signals made by the deaf in front of a camera.

Therefore, the requirements for the construction of TRADUZ arose from this analysis, trying to fill in the gaps that can help and assist the navigability of the user within an accessibility tool.

5. Limitations Found

5.1 TRADUZ Avaluation

Among the limitations found it is worth noting the use of signal recognition technique in digital images, since it did not have open source. Thus, adaptations were necessary to perform the signal recognition using the camera.

In the LIBRAS aspect, it has a differentiated semantics of the Portuguese language, which often does not allow the French translation with precision and understanding.

In addition, it was not possible to evaluate the tool with listeners and PwD from France due to the difficulty of going to this country.

On the other hand, the tool was used by PwD, and LIBRAS and Portuguese speakers from Brazil, being possible to observe the slowness in the presentation of the videos in LFS caused by the excessive size of the file which in an Internet connection without bandwidth it limits the transfer rate between the server and TRADUZ.

Furthermore, it was also perceived the need of making TRADUZ available to be downloaded and not stored for execution directly on a server and to be accessed through an electronic address, as in the beginning it was the purpose of the work because the method of signal recognition uses a technique that requires a lot of computational power, and with many connected users, the server might not support the connections and would make it impossible to use it.

Another limitation that can be used as future work is the ability of the tool to work as a mobile app on devices running Android or iOS.

6. Conclusions

This work reached its goal which was to carry out and develop a tool to aid people with hearing disabilities, making them able to learn a new sign language and also compare LIBRAS with the French Sign Language.

As benefits, it can be mentioned the possibility of the community on having a new method to mediate communication between Portuguese and French speakers, such as LIBRAS and LFS, even with the purpose of a non-simultaneous translation, stimulating learning through practice and the use of the tool.

However, this tool needs to improve on technological aspects, such as using image recognition algorithms that allow a 3D analysis of the movements made by the user. Also, it can be evaluated by a greater number of PwD from Brazil, and also be tested by French users.

As future works, it is suggested that an algorithm to help image recognition could be developed, which in turn may be able to recognize the movements and capture an approximate sequence of the images and classify them for the image recognition algorithm use, once users must wait for the signal to be captured so that it can represent another signal and follow the constant communication.

It is worth mentioning the importance and contribution of this work to social integration and technology expansion for the population, providing methods and tools to help human beings communicate with each other, among two countries with similar sign languages, but still culturally different, even though not yet mediating all the conversation between the interlocutors.

However, not only academic centers should be engaged in social integration work through new technologies. Private and public companies can support more projects that open doors for new applications to emerge and help people to have a better quality of life.

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