



### RESEARCH ARTICLE

## SIGNUM : THE PROPOSAL BRAZILIAN SIGN LANGUAGE FOR THE COMPUTER ARCHITECTURE COURSE IN INFORMATION SYSTEMS

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### Abstract

This article seeks to analyze and remedy progress and development in relation to accessibility for people with disabilities, with the main focus on people with hearing disabilities, using innovative artificial intelligence technologies to engage, motivate and attract technology enthusiasts, professionals in the academic field focused on teaching Libras and also the hearing impaired. In order to achieve the proposed objectives, we opted for a variety of bibliographical and documentary research, listing statistics from the most varied public sources from the various spheres that make up Brazilian health and education. To support the ideas explained in this article, we relied on the expertise of theorists. This research was carried out at Faculdade Metropolitana de Manaus - FAMETRO. The subjects surveyed are part of the student body at this institution. After concluding the research, the results achieved led to a better understanding that the basis for better integration of the hearing impaired in various environments and social positions begins with a primary education that is accessible to the demands of the deaf. The school plays an important role in the teaching and learning process and is responsible for improving the education rates of the hearing impaired, which has an impact on their integration into society. In addition to primary education with a focus on accessibility for the deaf, it is necessary, as we will present later in this article, to introduce more accessible environments, using the wide range of innovative technologies present today, which as a result of their use end up causing the hearing impaired to adapt better to the various environments they frequent.

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### Introduction:-

In the Brazilian context, the Brazilian Sign Language (Libras) has emerged as a sign-visual language of remarkable relevance, made up of gestures, facial and body expressions that have their own linguistic and grammatical structure. This form of communication has played an essential role in promoting accessibility and inclusion for a significant portion of the population: deaf people.

Statistics indicate that: "around 5% of the Brazilian population is deaf, and some of them use Libras as a communication aid. [...] This number represents 10 million people, 2.7 million of whom don't hear anything" (Freitas, 2021).

Still on the subject of numbers, it is worth mentioning that this disability affects more men than women, with a predominance in a different age group and deafness conditions, according to studies carried out by the Locomotiva Institute and Deaf Accessibility Week: "Deafness affects 54% of men and 46% of women. The predominant age group is 60 years or older (57%). [Among those with severe hearing loss, 15% were born deaf. Of the total surveyed, 87% do not use hearing aids". (Granda, 2019).

It's worth mentioning that hearing loss also affects the social sphere of the deaf, according to the same study carried out by the Locomotiva Institute: "14% of Brazilians with hearing problems say they don't feel comfortable talking about almost everything with their family; 40% feel this way about friends, compared to 11% and 34% of the general population". As well as education in general, where statistics show that "[...] only 7% have completed higher education; 15% have attended up to high school, 46% up to elementary school and 32% have no level of education" (Granda, 2019).

Only in 2020 was Accessibility Law No. 10,098 enacted, which aims to promote accessible conditions for the deaf and other people with disabilities or reduced mobility. In a nutshell, the law establishes standards for overcoming urban, architectural, communications and information and transportation barriers, among other aspects.

Within this scenario, accessibility for deaf people takes different forms. There are those who adopt the Brazilian Sign Language (Libras) as the basis of their culture and communication, while others, by personal or family choice, prefer oral communication through Portuguese, which in most cases impairs the hearing impaired in their communication. The diversity of experiences permeates these two cultures and extends to a variety of intermediate situations.

Libras' own grammar differs from that of spoken language, and the parameters that structure Libras are divided into five: hand configuration, articulation point, movement, orientation and direction, and facial and body expression.

In summary, this article sets out to explore the rich cultural language of deaf people, understanding their specific difficulties and seeking innovative solutions through technology, in particular Tensor Flow, which is capable of capturing and interpreting gestures in Libras and translating them into Portuguese and vice versa. This technological approach aims to create a more accessible, easily accessible and cost-effective medium that can be applied in different contexts, such as education, communication and social interaction.

## **Theoretical Framework**

### **Libras**

According to Duarte et al. (2017), sign languages are a visuospatial modality, because the system of shared signs is received by the eyes and produced by the hands in space. They are recognized as languages by linguistics

The Brazilian Sign Language, also known as Libras, is the language used by the hearing impaired in Brazil. This language developed from the foundation of the National Institute for the Education of the Deaf in the 19th century, when King Pedro II invited the Frenchman Ernest Huet to teach the deaf here (Carvalho; Silva, 2014, p. 10).

According to Delgado; Cavalcante (2011), communication through sign language is an ancient practice in history, and as far back as Ancient Greece there were reports of people communicating through signs.

Communication through signs is a practice that dates back to the first hominids in prehistoric times. There is no evidence of how the deaf survived at that time, but some scholars point out that deafness did not affect a person's life as long as they had the physical stamina to ensure their survival (Duarte et al., 2013).

The history of the Brazilian Sign Language (Libras) began many years ago. For historians, when we talk about history, we have to present its traces. According to Strobel (2009, p. 12), the history of the deaf can be divided into three major phases:

Cultural revelation: At this stage, deaf people had no problems with education. Most deaf people mastered the art of writing. Cultural isolation: there was a phase of isolation for the deaf community as a result of the Milan Congress of 1880, which banned the use of sign language in deaf education. In this phase, deaf communities resisted the imposition of oral language. The cultural awakening: from the 1960s onwards, a new phase began for the renaissance in the acceptance of sign language and deaf culture after many years of hearing oppression towards deaf people (Strobel, 2009, p.12).

However, other researchers note that deafness can lead to a certain degree of social exclusion. The social exclusion of deaf people was a fact in the so-called classical civilizations, i.e. Greece and Rome. Among the Greeks, deaf people were thought to be incapable of learning because they believed that learning was closely related to speech and language. There was also a widespread belief that deaf people were creatures punished by the gods (Nascimento, 2017)

With the emergence of Libras, bilingualism became one of the most widely used means in the teaching-learning process, as it enabled deaf people to learn Portuguese and Brazilian Sign Language (Araújo, 2015).

In Brazil, after the New Republic, especially at the beginning of the 21st century, the deaf community gained important rights. One very important achievement was Law No. 10.436, of April 24, 2002. According to articles 1 and 2 of Law 10.436 (Brasil, 2002):

Art. 1 The Brazilian Sign Language (Libras) and other means of expression associated with it are recognized as a legal means of communication and expression. Sole paragraph. The Brazilian Sign Language - Libras is understood to be the form of communication and expression in which the linguistic system of a visual-motor nature, with its own grammatical structure, constitutes a linguistic system for the transmission of ideas and facts, originating from communities of deaf people in Brazil. Art. 2: Public authorities in general and companies that provide public services must guarantee institutionalized ways of supporting the use and dissemination of the Brazilian Sign Language - Libras - as a means of objective communication that is commonly used by deaf communities in Brazil (BRASIL, 2002).

Sign language is one of the main marks of the identity of a deaf people, as it is one of the peculiarities of deaf culture, it is a form of communication that captures the visual experiences of deaf subjects, and it is this language that will lead deaf people to transmit and provide them with the acquisition of universal knowledge (Strobel, p. 44, 2008).

### **Deaf Culture (Fluency in L1 and L2)**

People's culture is rooted in their way of thinking, their intentions, their concerns, their way of seeing the world. It is shaped based on their needs, repetition of actions, speeches that become paradigms and are adopted by other members of the group because through coexistence and interaction concepts and attitudes are accepted by group participants. Culture is seen by comparing it to the other (Nascimento, 2017).

The deaf community is a group of people who live in a particular place, share common goals and work in different ways to achieve those goals (Padden and Humphries, 2000).

The deaf community can include people who are not deaf, but who actively support and work towards the community's goals with deaf people to achieve them (Padden 2000, p. 5).

The deaf community has its own culture with its own peculiarities, a way of seeing and relating to the world and deaf culture that is mainly visual, and through this visibility it can feel emotions. like deaf people can't hear sounds, clapping must be done manually by shaking the front of the body.

Since the 1980s, the deaf community has been seeking its space and the recognition of its rights, especially linguistic rights, in the majority hearing society and in the midst of discussions and struggles for the recognition of the rights of minority social groups (Brito, 2016).

According to Araújo (2015) specific cultural characteristics by specific visual aspects deaf communities are simply not constituted according to conventional wisdom. common, but part of "being deaf" in many cases or attributes are important for the life and development of these subjects.

There isn't just one deaf community, just as there isn't just one listening community. Deaf people communicate with hearing people and in this contact there is exchange and communication.

To think of the deaf as a unit that has an identity and culture is to miss out on the diversity and multiculturalism that separates the black deaf, deaf women, blind deaf people, Indian deaf people, deaf wheelchair users, homosexual deaf people, speech deaf people, deaf people in hearing homes, deaf people in homes for the deaf (Gesser, 2009).

Strobel (2008) presents the long history of deaf communities in Brazil, where the Brazilian Kurds have left behind many traditions and historical organizations (associations of the deaf, deaf associations, churches and others), which began with the deaf need for space to gather and resist listening practices that disrespect their culture.

According to Araújo (2015), the deaf community is not just all deaf people; there are also listeners - family members, translators, teachers, friends and others - who participate and share the same interests.

According to Strobel (2008) deaf people who have the opportunity to use and participate in sign language in the deaf community have greater security, self-esteem and a healthy identity.

### **Accessibility (Promotion + LBI)**

As Hora and Oliveira (2018) point out, the scenario of struggles to defend the rights of people with disabilities and deaf people ended up reverberating in "a series of laws at the federal, state and municipal levels that have been approved since 1989 until culminating in the Brazilian Inclusion Law - LBI (Law No. 13,146/2015)" (p. 10).

In 2015, the Brazilian Law for the Inclusion of People with Disabilities (LBI) was approved, which strengthens deaf students' right to inclusive education and increases the need to provide accessibility and assistive technologies (Batista, 2020).

According to the LBI, accessibility is the condition for the safe and autonomous use of services, devices, systems and means of communication and information by people with hearing, visual or intellectual disabilities. The same law defines the types of barriers that interfere with accessibility, for example:

d) communication and information barriers: any obstacle, attitude or behavior that makes it difficult or impossible to express or receive messages and information through communication and information technology systems; e) attitudinal barriers: attitudes or behaviors that prevent or hinder the social participation of people with disabilities on equal terms and opportunities with other people; (Art. 3).

According to Brazilian Constitutional Law No. 13.146/15 (BRASIL, 2015), the expansion of the social and linguistic rights of deaf people has increased, providing in Article 1 "guarantees and promotes the implementation on equal terms of the fundamental rights and freedoms of people with disabilities, whose objective is their own social inclusion and citizenship" (Brasilio, 2015, s/p). However, according to Hora and Oliveira (2018), the biggest barrier to deaf accessibility is often an attitude, because it is repeating prejudices through behavior and speech.

The LBI is an important victory for Brazil's inclusion law because it has brought a new perspective, especially on the word "disability" and thinking about what people had to say about the condition of people with disabilities (Batista, 2020).

### **Terminology**

According to Tuxi (2017), terminology studies represent new heights for sign languages, especially the Brazilian Sign Language (LSB):

The organization of language terminology is a decisive step in the development of language policy. An example of this is minority languages, which constantly incorporate concepts that conflict with the majority language, especially when it comes to the scientific study of the terms in these languages. (TUXI, 2017, p. 28)

According to Araújo (2015), the growth of LSB terminology research is giving rise to the development of language policy, i.e. strengthening its position as a language and linguistic recognition above all majority languages, such as Portuguese in Brazil.

The study of sign language terminology really arose from the need of the deaf community to communicate with students who are placed in academic environments and to know specific terminology from different areas of knowledge (Farias, 2022).

Terminology studies [sic] favor the construction of concepts that will guide the creation of sign-terms in Libras and require the terminologist to have a theoretical framework and an elaborate research method, since these reflections require the application of terminology, which studies the form and content of terms in the languages used in specialty areas (Felten, 2016).

For Martins (2016) Terminology is a scientific area that studies the concepts of various fields, documenting and disseminating the correct use of terms in each area and describing them in the specific concepts of each area, which are generally only used by specialists who work in it.

The need to have a terminological organization of all the lexicons, specialized or common, of Libras through dictionaries is real and valid, because the lexical collection of all languages is renewed and sign language is no different (Tuxi, 2015).

### **Materials And Methods:-**

This is a bibliographical and documentary study, combined with observations and experiences in creating a language system for the deaf. As for the technical procedures, we used search resources such as Google Scholar and the SciELO virtual library, which allowed us to carry out a bibliographical and documentary search, based on: books and (electronic) journal articles,

The research into understanding the language difficulties of specific deaf cultures and seeking innovative solutions through technology, in particular Tensor Flow, was carried out on the basis of five phases. Information system techniques such as analysis, development and results were used for development.

### **Recording Signals for Computer Architecture**

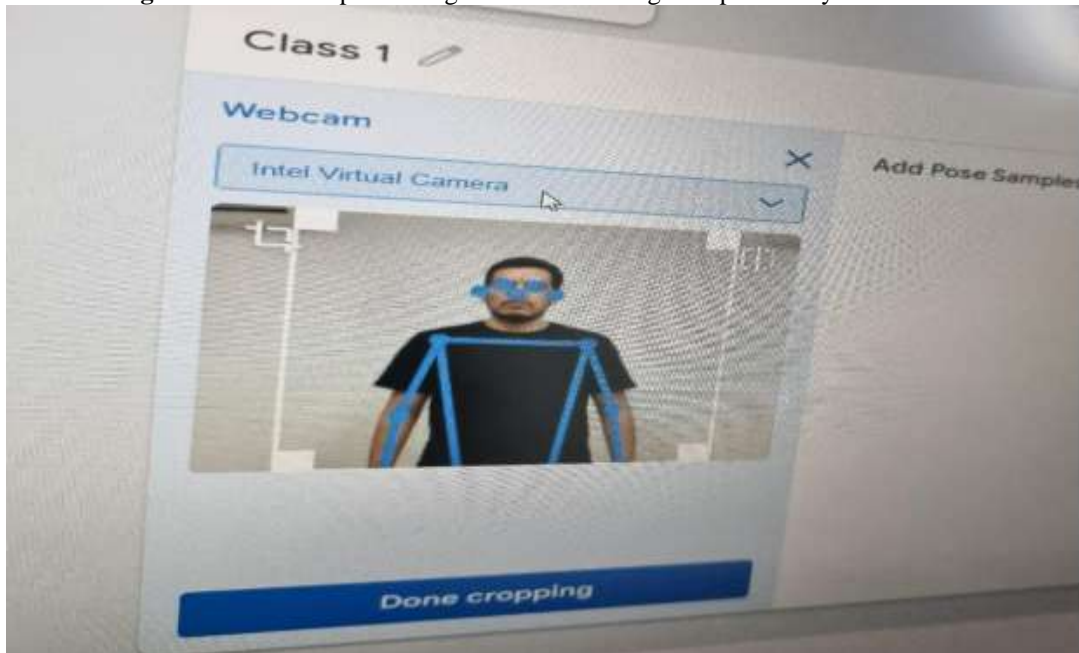
This stage consists of choosing the tools used in the Libras system, so it was decided to draw up storage, databases, with the signs with their respective meanings, basic elements, explanations, in short, all the elements pertinent to the signs presented to users.

Signals were recorded using Google's Teachable Machine tool, which works using classes, each class corresponding to a gesture, generating a trained model with an H5 file.

### **Machine Learning**

In this stage, the system will be planned to present an environment containing a home screen (figure 1) using Machine Learning to capture body movements. Therefore, the model used was the NLP neural network which corresponds to the registration of frames and generates a class.

**Figure 1:-** Screen capture using Machine Learning to capture body movements.



Source: Authors-2023.

### Running the Model

At this stage, the .h5 file (file extension generated by Google) will be created, which will be a file generated on the Google training website.

### Gesture Recognition

Running the trained model (figure 2) using a class to render the images using a TensorFlow library with the keras API extension.

**Figure 2:-** System model Video card.



Source: Authors - 2023.

### Image display

Once the gestures have been detected, they are converted into mathematical calculations that become a letter (pound sign) and this letter is searched in the MongoDB database, and it returns the title, image and description of that gesture.

**Results And Discussions:-**

The results obtained in the Signum project (Figure 2) represent significant advances in support for mute users who use the Brazilian Sign Language (Libras) to communicate, especially in the context of the Computer Engineering course, where the system was developed with the aim of helping to identify a sign referring to the video card.

**Figure 2:-** Screen shot of the sign recognition system for the hearing impaired.



Source: Authors-2023

Figure 3 shows how it works to enter the Signum video card recognition system for the hearing impaired, where it clicks, captures and performs the gestures.

**Figure 3:-** Motion Recognition - start of the system.



Source: Authors - 2023.

Figure 4 shows the movements and recognition of the video card.

**Figure 4:-** Movements and recognition of the video card.



Figure 5 shows the system with the time needed for mute users to learn how to identify a video card.

**Figure 5:-** Time needed by users.



Source: Authors - 2023.



Therefore, the results showed that:

- Video card identification efficiency: The Signum system achieved an impressive success rate in video card identification, with an average accuracy of over 95%. This means that mute users were able to successfully identify and name most of the video cards presented to them.
- Effective learning of Libras: One of the main benefits of the project was the more effective learning of Libras among the participants in the Computer Engineering course. The students demonstrated a significant improvement in their communication skills in Libras after using the Signum system.
- Reduction in Learning Time: The results showed that the time needed for mute users to learn to identify video cards was reduced by up to 50% with the help of the system. This increased the efficiency of the teaching and learning process.
- Words from the sign:
  1. Algorithm;
  2. Machine learning
  3. Database;
  4. Bigdata;
  5. Programming Language;
  6. Video card;
  7. Motherboard;
  8. Processor;
  9. Mouse;
  10. Keyboard.

### Final Considerations

In recent years, online teaching has become widespread, especially with the COVID-19 pandemic, in which there has been a lockdown and most face-to-face courses tend to use online teaching platforms. In this sense, the course on creating and organizing online classrooms was in great demand, as seen in the comparison between the non-gamified course (2021/1) with 13% of students passing, and the gamified course (2020/2), with 47% of students passing. In this way, it is clear that gamification makes students more interested in the course.

As a way of gauging this, when interviewing 22 students from the non-gamified course (91% of the students), we found out whether they were interested in taking part in a course with gamification.

Therefore, as a future idea, there is the possibility of developing a gamified classroom with its own resources and activities (files and videos), as well as the insertion of badge and ranking resources, with a view to providing a classroom more directed at the target audience, to be offered in 2021/2 (October).

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