

Universal Design and User-Centered Design: A UX Methodology Applied to the Democratization of Telesservices for People with Disabilities

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Abstract—The study addresses the precariousness of accessibility in Brazil, which directly impacts the autonomy of millions of Brazilians—from the 14.4 million with severe disabilities to a much larger portion that faces mild or temporary limitations. With the COVID-19 pandemic, telemedicine has become essential, but rapid technological development has often ignored inclusive parameters. In this context, the research proposes a methodology of UX User-Centered Design and Universal Design to create teleservice systems accessible to people with visual and hearing impairments. By prioritizing UX (User Experience), the product enhanced beyond functionality, reducing rework and transforming technology into a humanized and inclusive solution. This process generates high final value by democratizing access to healthcare and ensuring that interfaces are not barriers at critical moments. Although validated in telemedicine, this methodology is a highly scalable strategic differential and can be extended to various market sectors to increase user satisfaction and business competitiveness through inclusion.

Index Terms—Telemedicine, UX Design, Digital Accessibility, UI Design, Usability.

I. INTRODUCTION

IT IS A fact that the lack of accessibility in Brazil makes it increasingly difficult for people with disabilities to become independent and effectively active in society, especially when it comes to technology. According to Redação Galileu [1], less than 1% of Brazilian websites passed accessibility tests and only 3% of Brazilian government websites were approved at those tests in 2021. These data expose the lack of inclusion of people with disabilities in web development.

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Universal Design focuses on the development of materials that not only create adaptations for people with disabilities but include them as primary audiences. Multiple technologies are created every day for inclusion to happen in the broadest areas, but this topic is still left in the background or even completely abandoned by companies, often only receiving investment due to quotas required by law. With the COVID-19 pandemic and social isolation, everything has become a digital interface: customer service, communication, shopping, celebrations, and even visits to museums. Things that were already not easy or accessible, become almost impossible for people with sensory impairments. This lack of accessibility on platforms has further excluded and isolated a large part of the population.

For health reasons and to contain the spread of COVID-19, governments and companies invested in telemedicine and telehealth platforms, providing care, consultations, and prescriptions through video calls and apps. This strategy had positive results in reducing crowding in hospitals and health clinics, as well as helping control case data and facilitating communication with patients. However, it again excluded diverse types of users. Even in health-related contexts, there was little consideration for users' psychological needs, such as empathy, emotional support, and the need for human connection. There was also a lack of development using assistive technologies to create an inclusive digital environment.

In this context, it is necessary that User Experience professionals and the companies who develop these systems

study and apply User-Centered methods focusing on accessibility to embrace all the population.

II. LITERATURE REVIEW

A. User Experience (UX) and User-Centered Design

Nielsen and Norman [2], explain that “User Experience encompasses all aspects of the end-user’s interaction with the company, its services, and products”. While User Experience Design (UX) is a field whose main objective is the good usability of a product. Garrett [3] states that when using a digital product or service, the user is alone, without support or tutorials. He defines a digital product as a self-service product with no instruction manual to read beforehand.

This is one of the reasons why User-Centered Design is essential in the system development process. It is necessary to understand the user’s logical reasoning and anticipate how their interaction with the interface will occur.

B. Accessibility, hearing and visual impairments

According to Pinto [4], hearing is one of the senses responsible for the acquisition of speech and for the recognition of people, objects, and animals in the surrounding environment, due to sound processing.

Sonza et al. [5] defines hearing impairment “refers to the sensory loss of hearing; that is, the person gradually loses the perception of sounds until reaching the degree of deafness, which corresponds to the total loss of this perception”. Consequently, the acquisition of oral language is hindered. According to Pinto [4], congenital hearing loss occurs when the child is born deaf due to genetic or embryonic factors. Acquired hearing impairment, on the other hand, develops after birth due to external factors [5].

Regarding visual impairment, Sonza et al. [5] states that the World Health Organization considers visually impaired any person who is partially or totally deprived of the ability to see. Decree No. 5,296/04, defines blindness as visual acuity equal to or less than 0.05 in the better eye, with the best optical correction and low vision as visual acuity between 0.3 and 0.05 in the better eye, also with the best optical correction.

As for assistive technologies, visually impaired individuals may use screen readers, screen magnifiers, enlarged materials or braille for reading and writing. In this context, given the increasing demand for web accessibility, the W3C has developed guidelines aimed at raising awareness and facilitating the development of accessible systems. These guidelines have served as the foundation for numerous other standards and recommendations on the subject.

C. Telemedicine in Brazil

In Brazil, investment in the health system is already precarious and telemedicine is no exception. One example of recent investment in telehealth, more specifically teleservices, is ConecteSUS, the SUS (Unified Health System) app. It offers services such as digital health card, vaccination records, medication tracking, history of care and surgeries, and access to health news. The platform is user-friendly and available via

mobile apps or through a web browser using a social ID-based login on the government website.

The COVID-19 pandemic further accelerated the growth of telemedicine, creating urgent demand in cases of highly contagious diseases. With isolation and social distancing measures, the use of ICTs (Information and Communication Technologies) became essential. According to Garcia and Garcia [9], telemedicine activities help avoid close contact, reducing the risk of COVID-19 transmission, while also accelerating the dissemination of accurate information, supporting educational platforms, and enabling access to specialist opinions in remote areas.

Within SUS, the ConecteSUS App was developed to facilitate the management, documentation, and registration of patient information. However, regarding accessibility, no assistive technologies, or adaptations for people with disabilities were identified in the system. It also does not provide specific services or information tailored to users with disabilities, reinforcing existing barriers to access.

III. METHODS

A. Research Methods

The planning of the research is conducted through the development of a methodology for creating a specialized system in accessible telemedicine.

For the scientific methodology, this work is structured in the following stages:

- 1) Data collection and theoretical foundation: bibliographic research on UX Design, its tools and processes, telemedicine, and digital accessibility.
- 2) Analysis of similar systems and requirements research: market research to analyze usability and accessibility of existing telemedicine applications (ConecteSUS and Vibe Saúde), along with interviews to understand user needs.
- 3) Diagnosis: identification of the real needs of deaf and blind users, followed by prioritization of requirements based on importance and feasibility.
- 4) Analysis of viable solutions: development of a low fidelity prototype representing structural solutions, followed by usability testing with users.
- 5) Evaluation and Refinement based on user feedback, usability heuristics (Nielsen Heuristics) and accessibility guidelines (WCAG 2.0).

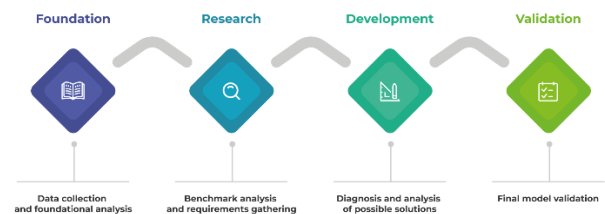


Fig 1. Research Methods

This research includes both qualitative and quantitative approaches. The qualitative aspect involves interviews and usability tests with open-ended questions to understand user needs and perceptions. The quantitative aspect involves

analysis of similar systems, and case studies. This study adopts an applied research approach combining qualitative and quantitative methods within a User-Centered Design framework. The investigation was guided by research questions and working hypotheses concerning the accessibility and usability of telemedicine systems for people with sensory disabilities. Data were collected through literature review, analysis of existing systems, interviews, and usability testing, allowing the proposed accessibility solutions to be iteratively refined and evaluated.

To guide the investigation of this the following problem was defined: How can a User-Centered Design methodology combined with Universal Design principles contribute to improving the accessibility and usability of telemedicine systems for users with visual and hearing impairments?

The hypothesis are: H1: The application of User-Centered Design and Universal Design principles contributes to the identification of accessibility barriers commonly found in existing telemedicine systems. H2: Accessibility adaptations derived from interviews, usability testing, and accessibility guidelines contribute to improving usability and navigability of telemedicine interfaces for users with visual impairments. H3: The incorporation of accessibility resources specifically designed for deaf and visually impaired users contributes to a more inclusive telemedicine experience.

The sampling focuses on a specific subgroup, namely people with sensory disabilities using telemedicine applications. Therefore, non-probabilistic sampling is adopted [12], meaning that the elements are intentionally selected rather than randomly chosen. As a result, there is no guarantee of representativeness of the analyzed population, and the findings cannot be generalized to the broader population.

Data collection and validation were carried out through interviews. Semi-structured interviews [11], characterized by the absence of a rigid script, allowing the researcher to explore topics more broadly and to guide the conversation in different directions, were conducted via Google Meet (remote). These interviews were applied to understand users' challenges, aiming to capture their experiences in a more direct and empathetic way. In this context, the study sought to examine usability issues, the use of assistive technologies, and how digital accessibility is implemented in telemedicine applications for people with disabilities.

By conducting interviews, it was possible to identify and understand what effectively benefits people with disabilities, which assistive technologies are most used, how frequently they engage with social networks and applications in their daily activities, and how these systems respond to their needs in terms of digital accessibility, both positively and negatively. At this stage, it is essential to develop empathy with users by analyzing the role of digital accessibility and universal design in their everyday lives, as well as how these factors contribute to a more inclusive and supportive society. These interviews were conducted both during the data and requirements collection phase and in the prototyping stage, aiming to obtain user validation of the proposed hypotheses and potential solutions.

The interview and usability test were conducted with a volunteer with low vision in one eye and total blindness in the other. Regarding assistive technologies, the participant uses the built-in screen reader VoiceOver on an iPhone and, on desktop, relies on Windows Magnifier in combination with the NVDA (NonVisual Desktop Access) screen reader. The use of mobile devices and computers is part of daily routine and accessibility issues are highly frequent. Situations in which the screen reader fails to recognize apps functions are common, requiring the user to take a screenshot and, with the aid of zoom, rely on residual low vision to understand what is happening on the screen. This type of adaptation would not be possible for users with total blindness.

The participant reported no prior experience with telemedicine applications. However, platforms such as Facebook, WhatsApp and Instagram were mentioned as positive examples of accessibility, as they tend to organize interface elements effectively, minimizing the presence of unlabeled components for screen readers. Buttons were identified as a recurring issue: in some cases, the screen reader interprets the associated text as dissociated from the button, while in others, there is no audio description of the button's function, leading to uncertainty for the user.

Pop-up windows were also highlighted as frequent obstacles, as screen readers often fail to detect these floating interface layers.

Overall, the findings suggest that auxiliary text, audio descriptions, the order and layout of interface elements, and the grouping of items are critical factors in designing interfaces for blind users. These aspects represent the primary sources of usability issues and frequent user frustration.

The usability evaluation conducted with the visually impaired participant should be understood as a pilot usability study. The objective was not to produce statistically generalizable results, but rather to identify accessibility barriers, verify the feasibility of the proposed solutions, and collect qualitative feedback to support iterative refinement of the prototype. As recommended in User-Centered Design approaches, early-stage usability evaluations can provide valuable insights for design improvement even when conducted with a limited number of participants.

Due to recruitment limitations, direct participation of deaf users was not possible during this stage of the study. Therefore, data regarding deaf users' needs were collected through interviews with professionals experienced in Brazilian Sign Language (LIBRAS) and communication mediation with deaf individuals. These findings should be interpreted as preliminary and exploratory.

Communication occurs primarily through video calls, that represent a significant advancement for the deaf community, as prior to their widespread use, platforms and social networks were limited to written Portuguese or prerecorded videos. Written Portuguese used by deaf individuals often presents distinctive characteristics, such as conjugation errors and missing prepositions.

Only recently has there been broader recognition that bilingual education, incorporating the sign language simultaneously, is the most effective approach for deaf individuals. Sign language is the natural language of deaf

individuals, acquired through interaction with other signers, in a manner similar to how hearing individuals acquire spoken language. Deaf individuals raised in hearing families may not experience natural language acquisition, whereas those in deaf families or in environments where sign language is used can develop it more effectively, forming a stronger cognitive foundation.

Technological accessibility emerges from the need to translate Portuguese into sign language, given that these are distinct languages with different grammatical structures. In this context, the use of simple, clear, and objective Portuguese in interfaces is essential. Sign language translation software is not widely used by deaf individuals, as many tools perform literal translations, ignoring context and failing to recognize various expressions.

The sign language teacher mentioned the OdontoLibras app, developed by the State University of Londrina, as an accessibility-focused initiative for deaf users. Unlike automated systems, its translations were performed by a deaf instructor rather than artificial intelligence, which improved contextual understanding and user experience.

Since video calling was already widely used, communication itself was not significantly affected during the pandemic. However, as various sectors adopted online platforms to maintain social distancing, deaf individuals often required assistance from others to complete certain daily tasks.

Videos and animations with captions or embedded sign language interpretation windows are essential for content comprehension and interface usability. Introductory tutorials explaining functionalities, procedures, and interface elements also support deaf users, improving both user experience and confidence when interacting with digital systems.

TABLE I

SYNTHESIS OF INTERVIEWS DATA

Use of simplified, objective, and basic language in the interface adapted for deaf users due to difficulties in acquisition, comprehension, reading, writing, and interpretation of the portuguese language;
Use of sign language translation for texts for deaf users who do not understand portuguese;
For sign language translation, use videos recorded specifically for the application, since artificial intelligence translators perform literal translations, ignoring context and failing to identify various words;
Use of explanatory videos in sign language to improve understanding of content, functionalities, and interface procedures, enhancing user experience and confidence in its use;
Avoid the use of pop-ups or floating windows, as there are common cases where screen readers do not recognize interface functions or layers, making the application unusable for blind users;
Use buttons and links associated with texts for screen reader identification;
Use objective and direct alternative texts, helping blind users understand the presented content;
Structure the interface in blocks, focusing on the order and arrangement of elements on the screen and grouping items, as these are key points for optimizing an interface for blind users;
Humanization and contextual understanding in translation are important factors that influenced the comprehension and inclusion of deaf users in the application.

B. Project Methods

The project methodology employed the following steps:

1. Analysis of similar systems to collect data on existing market interfaces and systems, performing usability and accessibility evaluations based on established guidelines.
2. Development of personas and user flow maps to identify key user needs and visualize interaction points and pain points throughout the user journey.
3. Research into possible solutions through UX and UI approaches, applying selected guidelines such as Nielsen's heuristics and WCAG accessibility standards.
4. Evaluation of proposed solutions with users to test initial concepts (for blind users, screen reader interactions were simulated through recordings).
5. Analysis of evaluation results to determine effectiveness.
6. Development of high-fidelity prototype incorporating approved solutions.
7. User testing (interviews) to evaluate system usability and accessibility.
8. Adjustments and refinements.
9. Finalization of development and research, resulting in a prototype of an accessible telemedicine App for deaf and blind users, based on User-Centered Design principles.

C. Analysis of Similarities

Through the analysis of similarities, it is possible to verify how competing digital systems use language and visual patterns, what resources they make available to users, and whether they follow usability and accessibility guidelines. The usability guidelines chosen to perform the analysis of similar systems were Nielsen Heuristics, while for accessibility analysis, WCAG 2.0 guidelines.

The first application chosen for the analysis of similar applications was ConecteSUS, an App of the Brazilian Government and, among telemedicine applications, one of the most used during the pandemic years. The second App analyzed was the free version of ViBe Saúde, a direct competitor.

1) *ConecteSUS*: Analyzing Nielsen's Heuristics, the App is mostly in line with usability guidelines. As for digital accessibility, it lacks several features and tools that could improve the experience of people with disabilities. It uses simple and objective terms that facilitate the understanding of deaf users. The icons used help in understanding the content and maintaining a good consistency and standardization, however, during the usability test, it was noted that they do not have audio description, ignoring the needs of blind people. In the background, a gradient in shades of blue-gray is used, which can impair contrast and, consequently, visibility and readability. For typography, the weights alternate in bold and regular to assist in the hierarchy of information, as well as texts in upper and lower case.

2) *ViBe Saúde*: although at first it appears to have a well-developed design and good usability, when a more in-depth

analysis of the heuristics was carried out, a lack of design centered on the user experience was noticed. As for language and visual communication, the Vibe Saúde App uses medical terms that can confuse users. In the background, it features a solid shade of gray that helps contrast the content.

Both applications severely lack accessibility and can improve the user experience and its usability if applying WCAG guidelines and Nielsen's heuristics, e.g. the visibility of the system status heuristic.

Some positive points were noticed and further used in the prototyping, such as minimalistic aesthetics, high contrast between text and background, easy-to-understand icons and confirmation screens.

D. Usability Testing with Similar Systems

Usability testing, or user testing, is a method that enables an analysis of the product, verifying whether it will meet the needs of users and solve their problems. It is possible to identify system errors, navigability problems, communication failure, lack of accessibility, and several others.

Garret [3] states that user testing is not about testing your user, but about getting your user to test the product. Both finished products that are in the process of redesign, and products still in the process of development, through prototypes, can be tested.

For this research, a usability test was carried out with the same Apps chosen for analysis of similar: ConecteSUS and Vibe Saúde, respectively. The user performed the test with the cell phone's own screen reader and has total blindness in the left eye with perception of shape and clarity and, in the right eye, has 3% visual acuity.

For the first activity, considering the pandemic context and an common issue to all people in their daily lives, the user was asked to generate proof of vaccination from COVID-19, provided in two ways on the system: a blue button centered in the bottom menu and a "vaccines" button in the quick actions on the home page. The activity took 22 minutes, making explicit the lack of accessibility: none of the images and icons featured alternatives text, requiring the user to interpret according to the remaining content. Upon arriving at the quick access menu, the user tried to click on the "vaccines" button, however, the apparent text on the screen was dissociated from the button, making it non-clickable and, consequently, excluding blind users from one of the few access options. Realizing that the link would not work with the screen reader (as well as all the others in the quick actions menu), the user followed the navigation in search of another option. When faced with the blue button centered in the bottom menu, the screen reader indicated: "button, close.png", without alternative text. The name of the button led the user to think that the button would close the App. It was necessary to navigate through all the pages available on all screens, including the FAQ on the governmental website. Because he had no other option, the user clicked on the blue button. When clicking on the button, the content opened in a floating window, being ignored by the screen reader and requiring the user to take a screenshot to use their low-vision eye to read the content and access it.

The following activities were faster. After the user became familiar with the system layout and, because he was forced to navigate all the pages to fulfill the previous activity, the requested screens were promptly found.

In the post-test analysis, the user declared feeling very confused, dissatisfied with the interface, and rated the level of difficulty as 5 (very difficult).

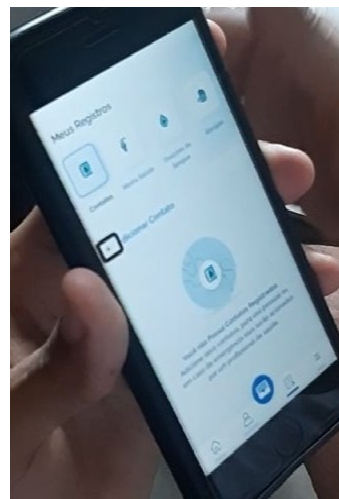


Fig 2. ConecteSUS usability test with screen reader

In the second usability test, a serious accessibility problem was noticed: the product had a server error, showing a screen with the logo, error message, and a button labeled "try again", as shown on Figure 3, in which none of the elements were identified by the screen reader, leaving the user unaware of their context or what action to take.

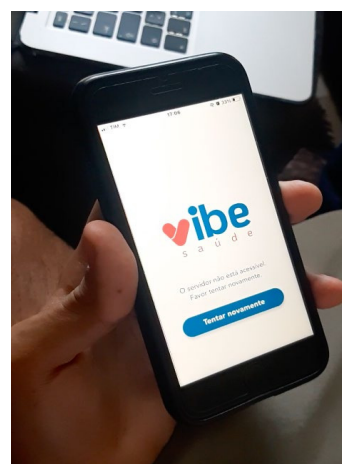


Fig 3. Vibe Saúde server error

As for the activities, the execution time was much shorter, all carried out in less than 2 minutes. The block layout allows the user to navigate simply and quickly through the available options. The user stated that the application was reasonably organized, expressed neither satisfaction nor dissatisfaction with the interface, and rated the difficulty as 4 on a scale from 1 (no difficulty) to 5 (very difficult).

About the registration process (done before the test), the volunteer reported significant difficulty. For ConecteSUS, desktop integration was used, but it required installing another governmental application, which also lacked accessibility.

Through the tests, it was possible to detect several design and technical development problems that result in serious accessibility failures, excluding and hindering access for people with disabilities to content that should be universally accessible. The problems and positive points identified will be used to guide the project, considering the use of assistive technologies, as well as the understanding of terms and icons by deaf users.

E. WIREFRAME

The wireframe developed in this research aimed to understand and visualize an option for adapting screens for people with disabilities, focusing on simplifying the standard layout and providing accessible resources. It is important to note that, as it focuses on the hierarchy and arrangement of elements, the wireframe should not have visual interference from colors and graphic elements, and its texts and shapes can be changed, if necessary, for the final prototype.

For a better experience for people with disabilities, it was defined that an specification page is the first step of registration, starting the accessibility process before the user accesses the system. In addition, the sign language window is already available on the home page regardless of the user’s needs. On the home screen, after the user’s specifications, the layout undergoes structural changes. If the changes are not specified, the user enters the standard interface, presented in Figure 5.

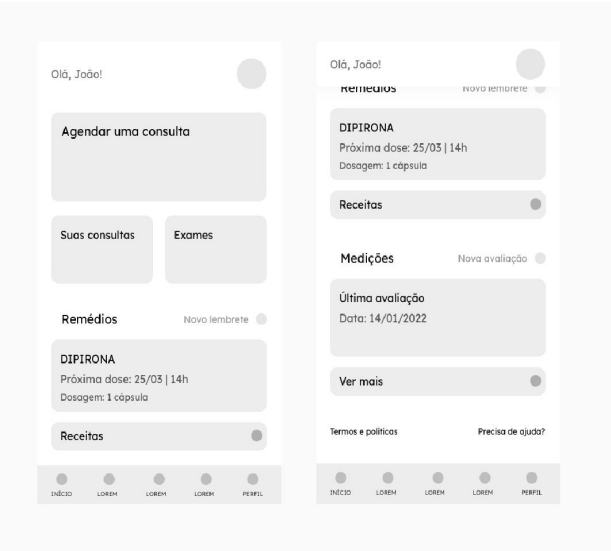


Fig 5. App Wireframe

For deaf users a floating box is presented with an introduction and brief tutorial in sign language, explaining the interface step-by-step. A sign language window is available to translate content when necessary, and sentences and terms are simplified. In addition, interface icons and images are replaced with icons in sign language.

For blind users, the adaptation follows a different approach, which involves the simplification and reduction of visual elements, adjustment based on screen reader navigation flow, addition of elements to improve understanding and navigability and the use of more efficient and objective auxiliary texts on buttons and images. For flexibility and user control, a help button and a dark/high-contrast mode control button are added to the interface.

F. Usability Testing

From the generations of alternatives developed in the wireframe, a high-fidelity prototype was created. First, a standard interface was created without accessibility adaptations using Nielsen’s heuristics and looking for already known usability patterns to result in a user-friendly interface.

To validate the high-fidelity prototype, a usability test was carried out with the blind volunteer, as shown in Figure 6. The author narrated the texts simulating the alternative texts of the elements as the user indicated his actions and thoughts. The narration simulated the screen reader, in which the user could choose between the options 1) continue to the next element, 2) click on the selected element, and 3) return to the previous element. With the eye of low visual acuity and photophobia, the user analyzed the dark mode and confirmed ease with reading the texts, being able to identify them at a greater distance than the light background mode. The structure of the blocks, use of header and alternative texts centered on the user’s needs, helped in the navigability and usability of the prototype. The user said he felt comfortable when browsing and found the pages he was looking for quickly and effectively. Texts and tables in table format are easier to identify and understand. Some information was indicated by the user as redundant, being removed from the final versions.

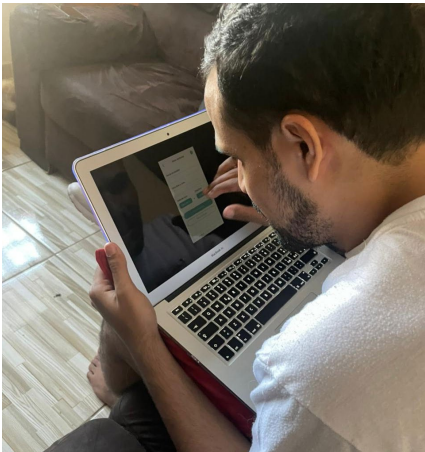


Fig 6. Usability testing with Medcall prototype

Table II synthesizes the most important data collected through the test.

TABLE II

SYNTHESIS OF USABILITY TEST DATA

Whenever is possible, organize information in a “table” format (data titles);

For editable data in profile areas, place the edit mode within each field, avoiding redirecting the user to an external page;
Keep pages free of pop-ups or floating windows;
Use direct and objective sentences in alternative texts.

IV. RESULTS

A. The product

After the adjustments and feedback from the usability test, the interface proposal for the MedCall App was created: a tele-medicine application developed with a user-centered design and based on User Experience. Following the aesthetics defined in the visual identity, a design system was created with the same basic characteristics. The standardization of these elements and the visual consistency between them helps in the consistency of the interface, making it more user-friendly.

The navigable prototype can be accessed at Adobe's sharing platform.

Following the list of requirements, the main functions of the application are:

- Online and face-to-face consultations
- Prescriptions, history, and medication reminders
- Guides, history, and access to exams
- History of medical evaluations (anamnesis)
- Accessibility for deaf users (sign language window, simplified language, and removal of decorative images)
- Accessibility for blind or low-vision users (simplified structure, removal of decorative images, dark mode, high contrast mode, and alternative texts)

B. Accessibility and Adaptations

As defined in the generation of alternatives, the process of choosing to adapt the interfaces occurs right at the beginning of the application, presenting accessibility options for the user even before starting to use its features.

If the user selects the accessibility button for blind people, for example, the application understands that they will opt for the options of dark mode and removal of decorative images, activating them automatically and offering other configuration options for greater flexibility of use.

The accessibility options are summarized as:

- Dark/night mode: dark backgrounds with light fonts help people with photophobia visualize information, increasing readability
- High contrast mode: stronger contrast between figure and background for people with low vision
- Removal of decorative images:
 - Increases navigation speed for screen reader users
 - Avoids confusion for deaf users with non-informative images
- Simplified language: replacing complex terms with simpler, more common language to improve understanding for deaf users

- Sign language window: videos recorded specifically for the application to translate interface elements and texts

The prototype for blind users was developed considering screen reader navigation and the use of the "Remove Decorative Images" feature. Icons were removed because they can slow navigation for blind users. In some application flows, the non-adapted interface uses step-by-step navigation instead of a header title to indicate progress. This can cause confusion for screen reader users, as such readers may not correctly interpret step flows. That feature was removed. To facilitate learning for deaf users, the prototype includes an introductory simulation in sign language for those who activated the "Sign language window" feature during registration. For the sign language translation feature, a window located in the lower right corner is available on all application screens and can be enabled or disabled by the user at any time.

C. Features, Screen Flow and Requirements

The main features (related to appointments, exams, medicines, and physical assessments) were made available directly on the app's home page, making it easier for the user to access without requiring a high cognitive load. For the scheduling of appointments, the user is asked to choose the month and then the day of the appointment, resulting in the available times. In the layout without accessibility, when choosing the date and month, an interactive calendar is offered, being more intuitive for users without disabilities. As it is a complex feature for screen readers, this option is removed in the layout adapted for blind people, being replaced by date options in list format. Confirmation pages avoid possible errors in filling in and selecting data, making the user review all information before confirming the action.

On the medicine screen, the main feature is "Add reminder", positioned at the beginning of the interface for easier access. Based on usability tests, the main requirements include saved medication history, access to prescriptions, adding medicines from prescriptions, and creating reminders. To create a reminder, the user provides the name of the medicine using a recall system (aligned with Nielsen's heuristic No. 6), along with start date, end date, and dosage interval. After usability testing, the inclusion of a start time or time option with interval definition was identified as necessary for greater flexibility. In edit mode, the "Cancel" option is replaced by "Delete reminder".

Regarding data editing, usability testing indicated that, for blind users, it is more effective and practical to perform edits directly within each element, rather than being redirected to a separate screen. As an intuitive and straightforward interaction, this embedded editing approach was implemented in editable forms for all users.

Due to the application's complexity, a fixed "help and FAQ" icon was added to the header. This directs users to an FAQ page and an AI-powered chat service. Questions are categorized, and a search bar is available. For deaf users, chatbot responses include videos and GIFs in sign language.

Finally, a message chat is available to assist in cases of connectivity or microphone issues and to support

communication with deaf users on online consultations. Additionally, an interpreter can join the call as a third participant when necessary.

V. CONCLUSION

The use of User Experience and User-Centered Design methodologies allowed the identification of the main errors and possible improvements during the research process, even before the development stage. The focus on the user and their participation during the creation process helped in decision-making, directing it toward real needs and reducing rework in later stages. With an in-depth research phase, usability tests with existing applications, and interviews with professionals and potential users, the creation stage became more assertive and aligned with actual user demands. The rework rate for the final interface was minimal, and usability test results with the prototype were positive. These findings support H1, as the analysis of existing systems revealed multiple accessibility barriers and H2 was supported through usability evaluations and iterative refinements that improved navigability for visually impaired users.

A limitation of this study is the restricted number of participants involved in the usability evaluation. Therefore, the findings should be interpreted as exploratory rather than conclusive. The usability testing performed with a visually impaired participant served as a pilot evaluation intended to identify major accessibility issues and assess the practical applicability of the proposed methodology. Future studies should include larger and more diverse samples of users with visual and hearing impairments in order to strengthen the empirical validation of the proposed approach.

H3 was partially supported by the incorporation of accessibility resources derived from public requirements and accessibility guidelines. The value generated lies in enabling fluid and inclusive experience. By integrating Universal Design principles, the product not only meets accessibility standards but also expands its reach, promotes digital inclusion, and improves user satisfaction. UX Design thus operates as a strategic component that enhances product quality and perceived value. The creation and development of applications and interfaces with an accessibility focus increase user satisfaction and contribute to the democratization of the internet and digital environments. All users have the right to a comfortable and secure digital experience.

Therefore, it can be concluded that the application of UX Design and User-Centered Design acts as a primary driver of

value in digital products. In the specific context of this research, applied to a telemedicine platform, user experience design proved to be essential: it not only facilitates access to healthcare but also humanizes digital services and ensures that the interface does not become a barrier during critical moments of care. Although validated in healthcare, the proposed methodology has broader applicability. Reducing rework, validating requirements early, and delivering consistent user experiences are principles transferable to various sectors, including finance, education, and e-commerce. Investing in UX strengthens usability as a competitive advantage and accessibility as a factor of social impact, resulting in products that are functional, efficient, and broadly valuable.

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