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Systematic Review on Mobile Application Interface Design for the Visually Impaired Community

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Abstract*– The purpose of this research is to understand the importance of the design and development of inclusive mobile applications for people with visual disabilities, addressing significant issues of accessibility and usability to promote digital inclusion and improve the user experience in Peru. A systematic review was conducted using a methodology based on the PICO and PRISMA method to ensure accuracy and transparency. In addition, scientific articles in English or Spanish from 2018 to 2024 were searched in Scopus, eliminating duplicates and selecting a final sample. The results indicate that the design of mobile interfaces for users with visual disabilities significantly improves digital accessibility. This approach solves problems such as missing labels and inadequate contrast, allowing independent navigation and promoting inclusivity. The integration of screen readers and contrast adjustments not only optimizes the user experience, but also strengthens their autonomy and productivity, highlighting the importance of these advances in creating more inclusive and accessible digital environments. It is concluded that the design of accessible mobile interfaces for users with visual disabilities improves digital usability by addressing problems such as lack of labels and inadequate contrast, promoting inclusion and digital independence in an equitable manner.

Keywords*-- Accessible design, inclusive design, interface design, user experience (UX), visual disability.

I. Introduction

User experience (UX) encompasses the overall impression an individual experiences when interacting with a website or mobile application, especially in relation to ease of use, efficiency and satisfaction [1]. Likewise, the relationship between Interface design and User Experience (UX) lies in the fact that both are intrinsically related to the user's interaction with a system. While interface design focuses on the visual appearance and the arrangement of elements to facilitate this interaction, user experience encompasses a broader vision that includes not only the visual interface, but also emotional and functional aspects that influence perception. of the user when interacting with the system. In other words, interface design is a crucial part of the user experience, as it contributes significantly to usability, accessibility, and overall user satisfaction with the system [1]. Therefore, both concepts complement each other and are essential to create a successful and satisfying interactive system for the user.

Currently, the design of mobile application interfaces for people with visual disabilities represents a significant problem in terms of accessibility and usability, since, as the use of mobile devices increases in Peru, there is growing concern about the digital exclusion of this community, reflected in the lack of attention to fundamental aspects such as alternative text in images [2].On the other hand, considering that the need to improve the adaptability of design and interactions for people with visual disabilities is recognized [3], attention to these needs in the design of mobile application interfaces is still limited in the Peruvian context.

A comprehensive solution to address the creation of mobile applications (APPS) for the visually impaired (DV) community involves several key aspects. Also, it is crucial to adopt a user-centric approach from the beginning of the development process. This involves conducting extensive research to understand the specific needs of visually impaired users, their challenges, and their preferences in terms of interaction and access to information. Techniques such as usability testing with real visually impaired users can provide valuable insights to guide interface design and application functionalities [2].

In turn, accessibility must be a fundamental principle in the entire process of developing mobile applications for people with visual disabilities. This involves ensuring that the app supports assistive technologies such as screen readers, screen magnifiers, and voice controls [4]. In addition to this, the implementation of inclusive design techniques, such as the use of appropriate visual contrasts, descriptive icons and a clear and coherent navigation structure, is also essential to improve the user experience and ensure that the application is accessible to all. users, regardless of their visual ability.

The choice of the topic of this systematic review on the design of mobile application interfaces for the visually impaired community is important, since, from a social perspective, digital inclusion is a fundamental objective in the promotion of equity and equality of opportunities for all citizens, including those with visual disabilities [1].In the same way, contributes to the development of the country, as it strengthens the knowledge available regarding terms of access to technology and digital services for all people, addressing the accessibility barriers that could exist in mobile application interfaces.

From a technical point of view, the design of accessible interfaces not only improves the user experience for people with visual impairments, but benefits the entire population by promoting inclusive and user-centered design practices [5]. However, the confirmation of the absence of recent or adequate systematic reviews on this topic in the country highlights the practical need to carry out this research. The lack of an updated review limits the availability of relevant

and up-to-date information for developers, designers and professionals interested in improving the accessibility of mobile applications in the country. Therefore, the conduct of this RSL is justified as a crucial step to fill this knowledge gap, providing a solid base of evidence and recommendations to inform practice and policy in the design of accessible interfaces for people with visual impairments in said country.

In this sense, the research is structured as follows: first, the methodology used during the RSL is detailed. In second place; The combination of results obtained from the search criteria used is presented. In third place; A summary of the qualitative and quantitative results is provided based on the specific objectives, allowing a deeper understanding for the appropriate design of mobile interfaces for people with visual impairments. Finally, the conclusions are presented, which serve as a basis for future research.

II. METHODOLOGY

Throughout this research, a methodological approach was established based on a systematic review of literature related to the Patient, Intervention, Comparison, Outcome (PICO) and Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) methodologies. To this end, it was considered that the PICO methodology is relevant for research, since it is based on a precise formulation of questions related to the topic that will contribute to having a clear vision of what is needed [6]. Furthermore, the PRISMA methodology is crucial to guarantee transparency and completeness in the presentation of systematic reviews and meta-analyses, since, by following the guidelines, effective decision-making can be expedited [7]. That said, the purpose of this research study is based on being able to design and develop inclusive APPS for people in Peru who suffer from some type of visual disability.

In this way, the functionality, usability and efficient aesthetics of said applications must be taken into account. To carry out this RSL, the methodology detailed in Table 1 was followed, which provides a summary of its application. This guaranteed a thorough and organized investigation. Also, scientific articles and conference papers published in journals in English or Spanish were searched using the Scopus database due to its reliability and quality of information. In turn, information was collected from 2018 to 2024 to ensure current primary sources and broad coverage of information given the expansion of scientific research in these years, such as what was rescued in [6] and [7], which coincide by highlighting the importance of following one or more methodologies for the preparation of research or review articles, since, in this way, it will be possible to have a clear and concise structure to achieve the proposed objective. In addition to this, keywords were combined to maximize the results, using Boolean operators AND and OR in the search throughout the database. Once this action was carried out, duplicate articles were eliminated, resulting in a final selection of articles for evaluation. Table 1 briefly describes the methodology considered for this RSL. user.

TABLE1. THE METHOD USED FOR THE SEARCH

Search criteria	**Parameters for searching information**			
Research question	What types of mobile interface designs optimize the user experience (UX) with Visual Impairment?			
Keywords used in the search	Interface design. User Experience (UX). Visual disability. Even design.		Accessible design	
Database	SCOPUS	WEB OF SCIENCE	SCIELO	ACADEMIC GOOGLE
Selection period	2019-2024			
language	Spanish		English	
Document type	Review		Conference Paper	
Accessibility	Open access			
Selection criteria	Process developed by 3 principals, comprised of 7 stages (figure 1).			

To detail the search in the review articles, the PICO question was broken down. This decomposition allows the information to be synthesized more clearly. The three questions formulated concisely are presented in table 2.

TABLE2. THE PICO METHODOLOGY

PICO structure	**Questions**
P	What types of problems can be solved with the application of mobile interface designs for Visually Impaired users?
I	What graphic design tools are applied to adapt the interfaces of mobile applications to improve the experience of users with visual disabilities?
C	What differences can be observed between mobile interfaces for users with and without visual impairments?
O	What specific improvements in user experience can be attributed to designing a mobile user interface for people with visual impairments?
GENERAL EQUATION	(TITLE-ABS-KEY (accessibilityORadaptabilityORinclusionOR"customizable typography"OR"intuitive navigation") AND TITLE-ABS-KEY ("Design tools"OR"User experience"ORcontrastOR"Usability testing"OR"prototyping tools") AND TITLE-ABS-KEY (usersOR"Visual disability"OR"Inclusive design"OR"Responsive Design"OR"UX Design") AND TITLE-ABS-KEY ("Personalized experience"OR"focus on usability"OR"Easy to use"OR"Mobile UI"ORimprovements))

After establishing the criteria, the search was carried out in Scopus, obtaining 426 articles. Likewise, for this article, no manual search was carried out in other sources of information with the topic investigated. In addition, a Boolean operator (OR AND AND) was applied where 383 articles that are not related to the topic investigated were identified and discarded. Obtaining a total of 28 potential articles for the RSL. Finally, articles were not excluded, since they had inclusion with the topic.

Figure 1 graphically presents the process of selecting scientific articles, using a PRISMA Flow Chart in four levels according to each stage worked on.

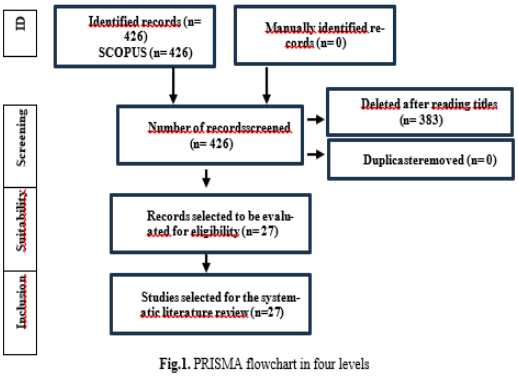

Fig.1. PRISMA flowchart in four levels

III. RESULTS

A. Bibliometric Results

In the Research, it is evident in the following graph that the designs of mobile application interfaces for the visually impaired community have been discussed since 1999 and it is, precisely, in 2018 that research on the interface design in recent years where interest has increased.

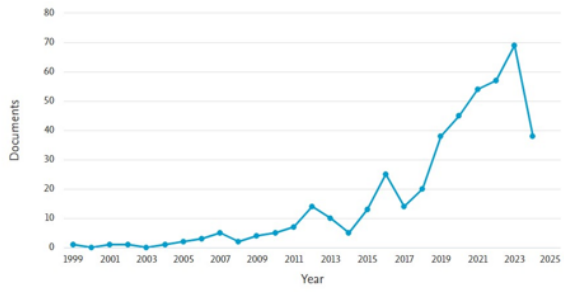

Fig.2. Graphic representation of documentation by year

Using the image shown below, you can identify the countries where a greater number of articles on the topic under study were discussed and developed, with the United States being the main country, since 92 documents from it could be collected.

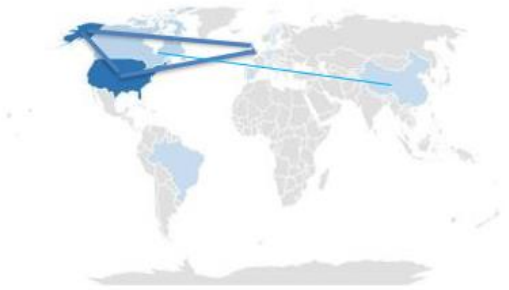

Fig.3. Countries with the greatest contribution in mobile interface design

It is worth mentioning that the analysis of the results will be useful for understanding and responding to the objectives present in the RSL, both general and specific.

IV. ENGINEERING RESULTS

Next, the information obtained in the 27 documents for this RSL is synthesized from the questions according to the PICO structure, namely:

P: What types of problems can be solved with the application of mobile interface designs for Visually Impaired users?

Inclusive and accessible designs significantly enhance the usability of applications, enabling visually impaired users to interact independently and efficiently with technology. For instance, these designs address critical issues such as missing labels, inadequate contrast, inaccessible buttons, and CAPTCHAs without alternatives, thereby ensuring smoother navigation and more effective interaction. As a result, by resolving these accessibility challenges, the designs not only improve the overall user experience but also promote equality and inclusion [8], [9], [20]. This is achieved by allowing flexible and enhanced interaction with applications, simplifying tasks on smartphones, and ensuring that visually impaired users can engage with technology in a way that is both autonomous and satisfying [27], [29]. Moreover, the focus on accessibility and usability ensures that visually impaired users can navigate applications with ease, understand content accurately, and interact with various features seamlessly. Consequently, by incorporating these elements, designers create a more inclusive digital environment that benefits everyone, fostering a sense of independence and empowerment among visually impaired users [21], [25], [34].

Furthermore, accessible mobile designs allow visually impaired users to navigate and access web-based information and documents that would not otherwise be legible. For instance, these designs can resolve problems of accessing university information for users with visual impairments, ensuring that academic resources are within reach. This

includes enhanced accessibility on library and government services websites, which are crucial for providing essential information and services [12], [17], [18]. Additionally, by improving the spatial experience and general navigation, these designs make it easier for visually impaired users to move through digital spaces confidently. Moreover, these accessible designs significantly reduce web accessibility barriers, ensuring that visually impaired users can interact with content in a meaningful way [19], [23]. This improvement in usability not only facilitates the independence of users but also enhances their daily activities, allowing them to manage tasks more efficiently. Consequently, by addressing issues such as limited accessibility and navigation difficulties on various websites, these designs empower visually impaired users to fully engage with digital content. In essence, by making web and mobile interfaces more inclusive, designers contribute to creating a more equitable digital landscape that supports the needs of all users [11], [28], [33].

Additionally, it was found in this RSL that mobile interface designs focus on improving the independence and productivity of users with visual disabilities. For instance, these designs address problems such as adherence to treatment, which is particularly crucial for older adults and individuals with physical and cognitive disabilities. By integrating solutions for reading and visual rehabilitation through applications equipped with magnification tools, these designs significantly enhance the user's ability to manage their daily activities independently. This includes tasks such as reading medication labels, navigating through daily schedules, and engaging in leisure reading, which are made more accessible through the use of magnification features and other assistive technologies [10]. Consequently, these designs not only improve the overall usability of mobile applications for visually impaired individuals but also contribute to their overall well-being by supporting their health management and daily routines [26]. The enhancement of independence and productivity through these mobile designs empowers visually impaired users to engage more fully with their environment, whether it is managing personal health, performing household tasks, or participating in social activities, thereby leading to a more supportive and enabling environment that promotes a higher quality of life [16], [30].

Likewise, mobile designs offer access to training in specific care, allowing caregivers to effectively manage conditions such as psychosis through accessible and inclusive training modules. Additionally, these designs enable the identification of colors and appreciation of works of art through tactile pictograms, enhancing the cultural and educational experiences for visually impaired users. Furthermore, mobile interfaces facilitate the control and monitoring of health problems by providing tools that allow users to track and manage their skin conditions independently [13], [14], [15], [22]. Accessibility adjustments in game applications also play a crucial role by improving usability for individuals with cognitive impairments, such as dementia, ensuring that these applications are engaging and beneficial. Improvements in the evaluation of upper limb movements are integrated into these designs, providing valuable feedback and rehabilitation support for users with physical disabilities. Importantly, these designs are addressed from the early stages of application development to ensure their effectiveness and usefulness, making them a vital component in creating inclusive and supportive technological solutions [24], [31], [32].

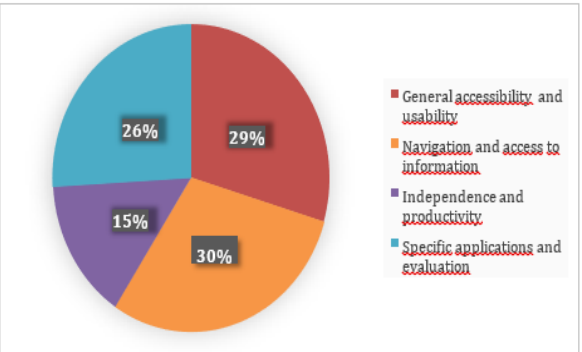

Fig.4. Problems Solved by Mobile Interface Designs for Visual Impairment

I: What graphic design tools are used to adapt mobile application interfaces to improve the experience of visually impaired users?

Tools such as MATE and platforms like Amazon Alexa Skills Kit ensure that applications comply with accessibility guidelines (WCAG and BBC) and adapt voice interfaces. MATE identifies and corrects accessibility violations, enhancing the user experience for visually impaired users by meeting established standards [9]. Amazon Alexa Skills Kit allows developers to create accessible voice interfaces, providing an alternative interaction method [10]. These tools facilitate the correction of accessibility errors through both manual and automatic assessments, ensuring comprehensive and effective solutions [11], [27].

Also, tools such as MIAV allow visually impaired users to assess the accessibility of web applications, providing them with valuable feedback on usability issues. In addition, auditing tools, manual review, and user feedback are used to adapt interfaces effectively. These methods ensure that applications meet the needs of visually impaired users by identifying and addressing potential barriers [17], [19]. Moreover, usability, user experience, and accessibility assessments are essential to improve specific platforms, such as virtual libraries and online government services. These assessments help in enhancing navigation, readability, and overall user satisfaction, making these platforms more inclusive and accessible for all users [21], [33].

The implementation of screen readers and tactile feedback is essential to improve accessibility for users with visual impairments. Screen readers play a crucial role in converting text into speech, enabling users to navigate digital content effectively. Additionally, contrast enhancement and

adjustments in font size enhance readability, while speech-to-text functionalities provide alternative input methods [18], [23], [25]. Tools like Talkback and voice assistants further enhance accessibility by offering adaptive interfaces that are intuitive and optimized for assistive technologies. These advancements ensure that interfaces are not only accessible but also user-friendly and supportive of diverse user needs. Integrating these tools and features contributes to making digital interactions more inclusive and accessible [26], [34].

The enhancement of accessibility features includes implementing high color contrast and adjustable fonts to improve readability for users with visual impairments. Textual descriptions for images ensure content comprehension through screen readers, promoting inclusivity. Clear iconography and a coherent spatial design aid intuitive navigation, enhancing overall user experience. Additionally, well-structured forms and alternative texts prevent conflicts with screen readers, ensuring seamless accessibility. Geometric patterns and consistent cell layouts provide accessible representations of colors, accommodating diverse visual needs. These design elements, highlighted by experts, contribute to creating interfaces that are both user-friendly and inclusive, catering to a broad spectrum of users [8], [12], [13], [15], [29].

It encompasses a range of innovations aimed at enhancing accessibility, including mobile applications tailored for diverse needs. Among these are interactive platforms dedicated to psychosis training, utilizing digital tools to simulate scenarios and promote learning accessibility. Additionally, mobile apps incorporating magnification and focus adjustment tools empower users with visual impairments to engage more effectively with digital content [14], [16], [20]. Tools for reconstructing and optimizing reports streamline data management, ensuring accessibility in information dissemination. Furthermore, apps such as MySkinSelfie facilitate dermatological self-care by enabling users to monitor skin health independently. Adapted games like Solitaire are tailored with features that enhance accessibility for individuals experiencing dementia, promoting cognitive stimulation and enjoyment. These advancements, advocated by experts, underscore the importance of inclusive design in technology, fostering independence and usability across diverse user demographics [22], [24], [32].

The empathetic and transdisciplinary approach in educational design emphasizes understanding and addressing accessibility needs across diverse user groups, ensuring inclusive access to educational materials and platforms. Experts identify various design technologies aimed at improving accessibility, usability, and user experience, integrating tools like UAUDG-VI to embed accessibility considerations from the outset of app development. This comprehensive approach not only enhances digital accessibility but also optimizes usability, creating intuitive and effective digital interactions for users with disabilities and promoting inclusive educational environments [28], [30], [31].

C: What differences can be observed between mobile interfaces for users with and without visual impairments?

Interfaces for visually impaired users are meticulously designed to prioritize accessibility and usability, leveraging features such as integrated screen readers, high contrast options, verbal feedback systems, and an intuitively organized layout of elements. These elements collectively enhance the usability of mobile interfaces by addressing specific challenges faced by individuals with visual disabilities. Unlike standard interfaces that often emphasize visual aesthetics and navigation primarily through visual cues, interfaces for visually impaired users integrate additional textual descriptions and intuitive layouts to facilitate efficient interaction. For instance, they ensure that all images are appropriately labeled, fields are tagged, and buttons are accessible, thereby overcoming barriers that could hinder navigation and comprehension [8], [9], [25]. The design process involves a careful consideration of tools like MIAV, which allows for specialized evaluations tailored to the needs of visually impaired users. These evaluations help identify and rectify accessibility issues that might otherwise impede effective usage [28], [19], [30]. Moreover, the emphasis on accessibility extends to ensuring that mobile interfaces not only meet regulatory standards but also enhance user autonomy and efficiency in digital environments. By adhering to these principles, mobile interfaces for visually impaired users strive to provide a seamless and empowering user experience that fosters independence and accessibility in the digital realm [26], [27], [31].

Touch interfaces designed for visually impaired users incorporate specialized features such as color-coded pictograms, non-visual navigation methods, and auditory feedback systems to enhance accessibility and usability. These adaptations compensate for the lack of visual elements by providing tactile and auditory cues that facilitate effective navigation and interaction with mobile applications. Color-coded pictograms serve as tactile identifiers for different app functions, while non-visual navigation ensures intuitive movement through structured layouts and directional cues. Auditory feedback provides real-time information and confirmation of user actions, improving the overall user experience by offering immediate guidance. These design strategies aim to empower visually impaired individuals to engage autonomously with digital technology, fostering inclusivity and usability [15], [23], [31], [34].

Mobile interfaces for visually impaired people also often incorporate specific assessment methods and are tested by users with disabilities to identify accessibility issues. This is in contrast to standard interfaces, which may not undergo such rigorous testing in terms of accessibility and usability for this user group [17], [32].

Some interfaces, like MySkinSelfie and SensHand apps, exemplify a dedicated approach to enhancing accessibility and usability for visually impaired users. These applications prioritize features such as screen reader compatibility, high

contrast visuals, and intuitive navigation, ensuring that visually impaired individuals can effectively interact with them. MySkinSelfie, specifically designed for dermatological care, integrates detailed verbal descriptions and tactile feedback options, catering to the specific needs of visually impaired users. SensHand focuses on usability and acceptance, utilizing innovative design elements like soft materials and ergonomic shapes to improve user interaction and accessibility. Moreover, interfaces tailored for the deaf community, unlike those for non-disabled users, prioritize accessibility through features such as visual alerts and text-based communication options, ensuring inclusivity and effective communication. These applications demonstrate a proactive approach to accommodating diverse user needs, fostering enhanced usability and accessibility across different user groups [18], [22], [24], [33].

Non-adapted interfaces have significant deficiencies in terms of descriptions, navigation, and contrast, making them difficult for visually impaired people to use. It also highlights the need to improve these interfaces to ensure a more inclusive and accessible user experience [29].

O: What specific improvements in user experience can be attributed to designing a mobile user interface for people with visual impairments?

Enhanced improvements in mobile user interface design for visually impaired users focus on integrating essential accessibility features such as screen readers and adjustable contrast settings. These enhancements ensure compliance with accessibility standards, thereby significantly improving usability and overall user satisfaction. By prioritizing intuitive navigation and addressing specific challenges faced by visually impaired users, these adaptations facilitate more efficient interaction with applications. Furthermore, initiatives like the redesign of library websites underscore the importance of accessibility, enhancing navigation, readability, and content comprehension for all users [8], [11], [13], [14], [16]. Early design considerations that integrate accessibility, usability, and user experience in ICT contribute to the development of more intuitive interfaces. These advancements not only streamline tasks but also promote inclusive access to information and online services, fostering digital inclusion and equitable user experiences across different user groups. Additionally, advancements in mobile technology continue to refine interfaces by anticipating and accommodating cognitive challenges, ensuring that e-services and applications are accessible and user-friendly for visually impaired individuals. These proactive measures aim to enhance navigation simplicity, readability, and fluid interaction with mobile applications, further enhancing the overall digital experience for users with visual disabilities [27], [29], [31], [34].

On the other hand, designing mobile application interfaces for people with visual disabilities empowers them to achieve greater independence in everyday tasks and specific activities such as report generation and health management. These interfaces are crafted to enhance efficiency and productivity by incorporating tools that facilitate precise task execution and easy access. For example, applications like MySkinSelfie and SensHand are tailored to meet the unique needs of visually impaired users. MySkinSelfie enables users to independently monitor and manage their skin health through intuitive and accessible design features. SensHand focuses on ergonomic and user-centered design principles, ensuring that individuals with visual impairments can interact seamlessly with mobile interfaces. These enhancements underscore the critical role of integrating accessibility features early in the design process to empower users and improve their overall digital experience [12], [26], [20].

Also, it is important to emphasize that personalization and adaptation to particular needs are crucial to improve user satisfaction and the effectiveness of the use of the application. Tailoring the interface to accommodate specific requirements enhances accessibility and usability for users with diverse needs, such as visual impairments or cognitive challenges. Features like customizable settings for screen readers, contrast adjustments, and navigation preferences empower users to interact more comfortably and efficiently with the application. Additionally, integrating adaptive technologies, such as ergonomic designs and intuitive interfaces, ensures a seamless user experience that addresses individual preferences and promotes inclusivity across different user groups. These efforts not only enhance user satisfaction but also support a more equitable access to digital resources, contributing to a more accessible and user-friendly environment for all [10], [24], [28].

Improving accessibility through rigorous testing and problem-solving ensures that mobile applications are designed to be inclusive and equitable, catering to the diverse needs of users, particularly those with visual disabilities. By actively addressing accessibility challenges identified through comprehensive user testing, developers can enhance the usability and satisfaction levels of individuals facing visual impairments. Clear instructions and expanded accessibility features, such as customizable fonts, high contrast modes, and voice-guided navigation, play a crucial role in creating a userfriendly experience. These enhancements not only meet stringent accessibility standards but also foster a digital environment where everyone, regardless of ability, can navigate mobile applications with confidence and efficiency. Such initiatives contribute to reducing barriers and promoting equal access to information and services online, ultimately enhancing the overall quality of life for users with visual disabilities [19], [30], [33].

It is worth mentioning that the use of assistive technologies and innovative approaches to improve the user experience help to develop solutions that improve usability and accessibility, benefiting not only people with visual disabilities, but also other communities with specific needs, such as deaf community [18].

V. DISCUSSION

The systematic literature review demonstrates that incorporating accessibility features into mobile interface design, such as screen readers, contrast adjustments, and voice commands, significantly enhances usability for visually impaired users. These features allow users to navigate applications more autonomously and efficiently, improving their overall experience [8], [9]. When comparing interfaces specifically designed for visually impaired users to standard interfaces, a greater focus on accessibility and usability is evident in the former. Accessible interfaces include textual descriptions for images and coherent navigation, facilitating the use of applications and promoting greater user independence [10], [11].

Several gaps and problems remain unresolved, such as the lack of awareness and training among designers about the specific needs of visually impaired users [12]. This gap in designer education hinders the implementation of truly inclusive solutions. Additionally, technological limitations and the absence of uniform standards complicate the adoption of effective solutions. In the Peruvian context, where digitalization is increasing, accessibility remains a considerable challenge. The lack of adequate technological infrastructure and the absence of public policies promoting digital accessibility exacerbate the situation.

The positive impact of accessible interface designs on user independence and quality of life is notable. Applications like "Be My Eyes" and "Seeing AI" have revolutionized the digital interaction of visually impaired individuals, providing tools that facilitate everyday tasks and improve productivity [14]. Best practices include using high contrasts, textual descriptions, and clear, consistent navigation essential elements for truly accessible design [13]. Adopting international standards like WCAG is crucial for improving accessibility [15], [16]. Several unresolved problems persist. The lack of awareness about digital accessibility and insufficient training for designers remain significant barriers. Additionally, technological limitations, such as incompatibility of certain applications with screen readers and poor quality of contrast adjustment tools, hinder the user experience. The absence of uniform standards also contributes to the fragmentation of accessibility solutions, making implementation inconsistent and often ineffective.

In Peru, addressing these gaps and problems is critical to avoid digital exclusion. Adopting best practices and international standards like WCAG is essential for greater digital inclusion and social equity. More research into emerging technologies and longitudinal studies is recommended to evaluate the long-term impact of accessible mobile applications on the lives of visually impaired users.

The systematic review also highlights specific graphic design tools used to adapt mobile interfaces. Tools like MATE and platforms like Amazon Alexa Skills Kit ensure applications comply with accessibility guidelines (WCAG and BBC) and adapt voice interfaces. MATE identifies and corrects accessibility violations, enhancing user experience by meeting established standards [9]. Amazon Alexa Skills Kit allows developers to create accessible voice interfaces, providing an alternative interaction method [10]. Additionally, tools like MIAV allow visually impaired users to assess web application accessibility, providing valuable feedback on usability issues [17], [19].

Advances in mobile technology continue to refine interfaces by anticipating and accommodating cognitive challenges, ensuring that e-services and applications are accessible and user-friendly for visually impaired individuals. These proactive measures aim to enhance navigation simplicity, readability, and fluid interaction with mobile applications, further improving the overall digital experience for users with visual disabilities [27], [29], [31], [34].

Designing mobile application interfaces for visually impaired individuals empowers them to achieve greater independence in everyday tasks and specific activities, such as report generation and health management. These interfaces are crafted to enhance efficiency and productivity by incorporating tools that facilitate precise task execution and easy access. For example, applications like MySkinSelfie and SensHand are tailored to meet the unique needs of visually impaired users. MySkinSelfie enables users to independently monitor and manage their skin health through intuitive and accessible design features. SensHand focuses on ergonomic and user-centered design principles, ensuring that individuals with visual impairments can interact seamlessly with mobile interfaces [12], [26], [20].

Personalization and adaptation to specific needs are crucial for improving user satisfaction and application effectiveness. Tailoring the interface to accommodate specific requirements enhances accessibility and usability for users with diverse needs, such as visual impairments or cognitive challenges. Features like customizable settings for screen readers, contrast adjustments, and navigation preferences empower users to interact more comfortably and efficiently with the application [10], [24], [28].

Assistive technologies and innovative approaches help develop solutions that improve usability and accessibility, benefiting not only visually impaired individuals but also other communities with specific needs, such as the deaf community [18]. Enhancing accessibility through rigorous testing and problem-solving ensures that mobile applications are designed to be inclusive and equitable, catering to the diverse needs of users, particularly those with visual impairments [19], [30], [33].

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VI. CONCLUSION

The systematic review demonstrates that designing accessible mobile interfaces improves the user experience for people with visual disabilities. Likewise, the integration of tools such as screen readers, contrast adjustments, and voice navigation is crucial for usability and autonomy. However, there are significant gaps in the education and awareness of designers regarding digital accessibility. Additionally, there are problems to be resolved due to technological limitations and the absence of uniform standards. In Peru, it is critical to address these gaps and problems to avoid digital exclusion; since adopting best practices and standards such as WCAG is essential for greater digital inclusion and social equity.

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