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Original Article

Mobile Application Design for Financial Inclusion of People with Visual Disabilities

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Abstract *- The limited accessibility of digital financial services for people with visual impairments is a major barrier to their economic inclusion and independence. The aim of this study is to design an accessible mobile app that allows this group of people to manage their finances, ensuring effective, secure, and independent interaction. To this end, the Design Thinking methodology has been used, structured around five phases: Empathize, Define, Ideate, Prototype, and Test. In the Empathize phase, the main accessibility needs were identified through a specific document review. In the Define phase, key requirements were defined, such as voice command navigation, a customizable interface, and auditory feedback. In the Ideate stage, multiple proposals were evaluated, and the proposal for a financial application was selected. The prototype was developed using the Figma tool and includes features such as voice-activated transaction reading and automatic categorization. In the Testing phase, seven experts evaluated the system technically, giving it a rating of 4.5 for auditory accessibility and 4.7 for auditory navigation. In addition, 42 users with partial visual impairment validated its performance, giving it a positive rating for accessibility (91.3) and overall satisfaction (90). In conclusion, the prototype is an innovative proposal for promoting the financial inclusion of people with visual impairments, with potential for implementation in various social and technological contexts.*

Keywords *- Design, Mobile app, Financial inclusion, Visual impairment, Voice Commands.*

1. Introduction

Currently, financial inclusion is a fundamental element for economic and social development [1, 2], as it allows access to essential financial services such as bank accounts, digital payments, and credit. However, people with visual impairments face multiple technological and accessibility challenges that restrict their active participation in the financial system [3-5]. The lack of inclusive and accessible infrastructure, inadequate digital interfaces, and limited training in inclusive technologies restrict this group's participation in the financial system [6], leading to economic and social exclusion. This limits their ability to carry out transactions, manage bank accounts, and obtain loans [7], increasing their dependence on third parties.

Nevertheless, globally, various initiatives aim to improve the financial inclusion of people with visual impairments [8]. Technologies such as screen readers, voice assistants, and intuitively designed applications have facilitated significant progress in user autonomy [9-12]. In countries like the United States and the United Kingdom, banks have implemented accessible technological solutions, promoting regulations that require digital integration in financial services [13, 14]. In Latin America, some countries have made progress in implementing inclusive technological solutions in the financial sector [15, 16]. In Brazil, the law requires banks to offer accessible services for people with disabilities, including ATMs with voice prompts [17]. Furthermore, in Mexico and Argentina, adapted banking applications with screen readers have been developed [18], facilitating communication between visually impaired individuals and their financial institutions.

In Peru, the financial inclusion of people with visual impairments still faces significant obstacles. Although some organizations have implemented accessibility projects, many digital platforms lack intuitive and easily navigable universal design. Public policies have promoted banking access; however, the absence of specific accessibility regulations limits the effective access of this segment of the population to financial services [19].

In this regard, the use of technology has proven to be a key factor in improving the financial inclusion of people with visual impairments [20, 21]. The implementation of accessible applications, Artificial Intelligence (AI), and virtual assistants allows users to conduct transactions autonomously and securely [22-24]. Compared to traditional methods, these technological solutions reduce dependence on third parties and increase the economic participation of this group.

However, a significant research gap remains: most previous studies have focused on technological accessibility or financial education independently, but few focus on the development of mobile applications specifically designed for the financial inclusion of people with visual impairments. This represents an unexplored research gap between accessibility, usability, and financial functionality. The purpose of this study is to address this gap.

Therefore, the novelty of this research lies in the definition of an accessible mobile application design that considers the criteria of digital accessibility, intuitive interaction, and security in a single, highly defined environment to respond to the needs of people with visual impairments. Unlike other studies, this perspective is inclusive and user-centered, building a tool that allows people a certain degree of autonomy and access to digital financial services for a wide variety of users.

The objective of this study is to design and validate a mobile application aimed at the financial inclusion of people with visual impairments, through effective, secure, and autonomous interaction with digital banking and financial services.

Finally, this study is structured into different sections. First, it includes a literature review, referring to research that is relevant to the objective of this work. Next, the methods used in the design of the application are presented. Then, the results obtained are shown, thus establishing the effectiveness of the proposed solution. Next, the discussion section is presented, which compares the results with those of the previous literature. Finally, conclusions and recommendations for future research are presented.

2. Literature Review

To begin, this section presents the findings compiled after examining the relevant publications identified while searching for works related to the fundamental objective of the research. Within this particular framework, both theoretical and applied studies focused on inclusive technology were found.

In this regard, study [8] emphasizes financial exclusion as a human rights issue that limits people's well-being. In this case, where people with disabilities live in low- and middle-income countries, the objective was to identify the factors that restrict and promote the financial inclusion of people with disabilities by delving into the importance of financial literacy and the use of digital tools for the purposes of this study. The research is framed within the methodology of Arksey and O'Malley, and also uses the PRISMA checklist, analyzing 26 different publications across academic areas. Similarly, [6] seeks to examine the financial inclusion established by the Palestinian Monetary Authority among this population. Based on a conversation between the researchers and bank representatives, during which responses to this study were analyzed in depth, it is concluded that limited financial knowledge, a lack of adaptive technologies, poor communication, and high poverty rates are the factors that sustain financial exclusion. Therefore, the study aims to formulate explicit obligations for the banking institution in relation to the integration of people with visual impairments.

In the field of technology, [25] details the application project for Android devices that facilitates personal finance management. Before implementing the app, the idea was validated through interviews with people who needed to check their balance in a simple way. They wanted alternatives for planning expenses, generating reports, reading barcodes, or viewing graphs. Alternative studies were also analyzed, and those offering the best results were chosen, in addition to connecting the application to an existing web app. Meanwhile, [24] presented an application that attempts to solve the difficulties blind people face when using financial products. It includes deep learning algorithms such as YOLO and ResNet, as well as voice recognition, and achieves 92% accuracy, demonstrating its potential to adapt the banking sector for improved accessibility. Similarly, [26] shows an accessible wallet that eliminates long sequences of menus and graphics that are not identifiable by screen readers. A robust backend for basic operations, such as recharges or payments, is achieved up to 94% of the time.

As a complement to the above, [27] developed an application that allows users to check, manage, and track their finances, thus facilitating decision-making in the area of personal finance. To carry out this activity, the development was organized into two stages: a first conceptual stage, focused on defining the main functions, and a second design stage, in which class and use case diagrams were created. In this way, the work culminated in an application designed to manage past, present, and future income and expenses. Along the same lines, [28] considers that the rapid evolution of technologies contributes to solving all the problems related to personal finance management. The objective of their work was to implement personal finance management software using the waterfall methodology and hybrid technologies such as Apache Cordova and Laravel in order to establish an accessible and efficient income and expense recording system. In turn, [29] proposes building a Personal Finance System (PFS) aimed at promoting financial well-being and economic stability. This system is based on logical rules and generates recommendations that support users in the decision-making process, which is extremely necessary in the context of the economic crises generated by the COVID-19 pandemic.

With regard to the automation of financial management, [30] refers to inequality and poverty as major global social problems. The research proposal consists of automating individual financial management and minimizing user effort through an application that captures SMS alerts for financial transactions, uploads expense invoices, divides accounts, and

automates the delivery of financial reports. And [31] proposes an application to help manage household finances; summarizing daily expenses, automatically updating exchange rates and assets, and providing forecasts on income and savings.

Regarding current accessibility technologies, accessible tools such as screen readers, voice assistants, adjustable contrast, refined touchscreens, and audio narration have gradually emerged; tools that allow people with visual disabilities to access digital services without needing the help of an assistant. The drawbacks of these technologies are particularly evident when we consider that most of the applications analyzed would be limited to not incorporating full accessibility, and even more so when we refer to the financial context, where security and accuracy are particularly indisputable.

In summary, the literature consulted shows that, although there are various proposals addressing the field of personal finance management and accessibility through digital technology, few studies strive to develop technology that integrates both proposals. Thus, it is clear that research mostly focuses on User Experience (UX) or financial literacy, but rarely involves accessibility as a pillar of social inclusion. In this sense, there is a scientific and technological gap in relation to the existence of mobile applications that can integrate the issues of advanced accessibility, financial security, and design focused on people with visual impairments. This absence is the starting point for this work, which aims to offer an innovative proposal geared toward financial inclusion through a functional mobile application.

3. Methodology

3.1. Design Thinking

The people-centered Design Thinking (DT) methodology is applied in this research due to its link to the ability to generate inclusive solutions [32], as it is a procedure that allows a response to be given to a specific problem and has proven applicable when linking human creativity with legitimate needs. In other words, it aims to innovate through motivation via cycles of empathy, definition, ideation, prototyping, and testing. The strategy applied can be seen in Figure 1.

3.2. Phases of the Methodology

3.2.1. Empathize

This phase focuses on understanding the context and barriers faced by people with visual impairments in managing their personal finances. Research [8, 24-26] identified significant difficulties in using tools adapted to the characteristics of these individuals, hindering their ability to achieve financial independence. Therefore, it was proposed to continue the study, as it provided a direct and necessary solution to address the identified problem.

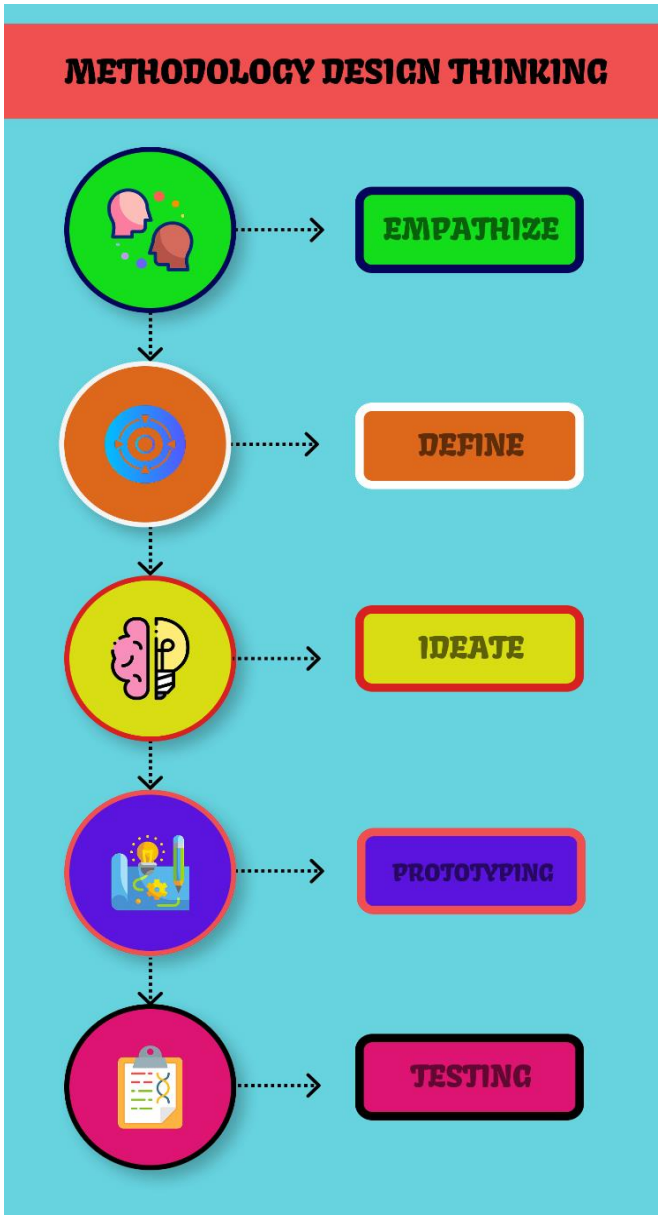


Fig. 1 Design Thinking Methodology

3.2.2. Define

This phase aims to gather and organize the information obtained and outlines the main functions to be considered in the prototype. This phase utilizes tables to organize the information and break down the general problem into specific needs. Therefore, we identify the key functions for accessing information: intuitive navigation, auditory accessibility, a clean interface, and immediate information, which will form the basis of the initial technological solution architecture.

3.2.3. Ideate

At this point, priority is given to the brainstorming session that the working group has proposed as possible solutions to the identified problem [33]. To this end, the working group held a session where they developed different alternatives

related to digital inclusion. Among the ideas that emerged were a screen reader for people with color blindness, opinion assistance software for people with myopia and astigmatism, and finally, a financial application for people with visual impairments. After selecting the three ideas that best fit the criteria of utility or interest, usability, and satisfaction with those criteria, the financial inclusion application was chosen as the idea most congruent with the research objectives.

3.2.4. Prototype

In this phase, it is feasible to present a first version of the final product to be developed [34]. The design tool used was Figma, as it is the most suitable software for collaboration and rapid development of interactive prototypes.

3.2.5. Test

The prototype, now in its final phase, will undergo technical evaluation by a panel of experts, comprising seven specialists in digital accessibility, interface design, programming, and UX design. The evaluation will involve a quantitative assessment using a form validated by experts, combined with a semi-structured qualitative interview covering more in-depth aspects. On the other hand, to identify the functional characteristics of this application, scores on a scale of 0 to 100 are collected from a group of 42 users with visual impairments, such as myopia, hyperopia, or astigmatism, and the information obtained is used to assess appropriate feedback. This number of participants is considered adequate for the initial validation of a prototype within a user-centered design approach, as it allows for the identification of trends, errors, and opportunities for improvement without the need for a statistically representative sample.

3.3. Tools Used for Prototyping

3.3.1. Figma

This tool was chosen as the main design and prototyping tool for the system to be developed, due to its integrated environment characteristics [35]. Its prototyping feature allows for rapid changes to be made to solve a problem during the design phase.

3.3.2. Google Forms

For prototype validation, Google Forms was used as a means to collect expert judgment data [36]. This instrument is a tool for collecting qualitative observations from interviews and, in turn, for organizing the experts' suggestions.

3.3.3. Power Apps

It is a tool that helps create custom applications, without needing to have very advanced technical knowledge about programming [37].

3.3.4. AI Builder

Its use lies in being a way to include AI in app creation and improve the user experience through automation and prediction [38]. Its integration into Power Apps allows the implementation of functionalities that help optimize interaction and personalize the experience for users with visual limitations.

3.3.5. Google Cloud Text-To-Speech (TTS) API

It is a tool that combines text-to-speech conversion within the application, allowing users to listen to content read aloud through their device [39, 40]. This tool allows users to choose from different voices and languages, making it a personalized experience. Furthermore, the following section details the testing process in more detail, including the tasks performed by participants: navigation, registration, balance inquiries, and use of audio functions; as well as the evaluation criteria applied.

4. Results

This section describes the results obtained from each phase of the DT methodology. The Empathize and Define phases are based on technical analysis of the literature and review of similar cases, while the Ideate, Prototype, and Test phases are based on internal work dynamics and external evaluation, taking into account expert opinion.

4.1. Results of the Empathize Stage

Although the DT methodology recommends contact with users, at this stage of the methodology, it was decided to conduct a structured and reasoned literature review as a valid and ethical way of understanding the needs of people with visual impairments, given the limitations of access.

This technique made it possible to identify the most common patterns in the literature on accessibility, adaptability, and financial application design issues. Table 1 summarizes the recurring needs that were found: auditory interfaces, ease of use, intuitive accessibility, and adaptability to environments. In short, the results obtained form the basis for the second and third phases, ensuring that design decisions are based on evidence from documented previous experiences.

Table 1. User Needs

Needs of Users with Visual Impairments		
Code	**Need Identified**	**Fountain**
N1	The interface is clear and simple	Literature analyzed [25]
N2	Ease of managing information and finances	Similar cases [26-28]
N3	Optimization of management time	Team analysis
N4	Intuitive accessibility	Validated by an expert
N5	Adaptability to different environments	Comparative review of existing platforms [24, 31]

The findings indicate that user requests relate to accessibility, adaptability, and design factors, and recommendations to be taken into account for future implementations are identified.

4.2. Results of the Define Stage

Taking into account the previously identified needs, the team concluded that there were five problems that the selected system had to solve. Each team member gave their opinion, assigning a score of 1 to 5 to each need, according to its importance. The scores assigned can be seen in Table 2.

Table 2. Problem Priorization

Problem Definite	Punctuation average
Lack of clarity in the interface	4.8
Difficulty in managing information and finances	4.6
Slow and disorganized processes	4.4
Limited accessibility for inexperienced users	4.2
Poor adaptability to different environments	4

4.3. Results of the Ideate Stage

In this stage, the team proposed three solutions. Each proposal was evaluated internally, assigning scores based on three criteria: design, usability, and user satisfaction. The most popular solution was the development of a mobile financial application adapted for people with visual impairments; the score for each proposed option is illustrated in Table 3.

Table 3. Evaluation of Ideas

Evaluating Ideas by Team Voting		
Proposal No.	**Brief description**	**Punctuation**
S1	Screen reader optimized for people with color blindness	15
S2	Visual assistance software for users with myopia and astigmatism	17
S3	Financial mobile application adapted for people with visual impairments	68

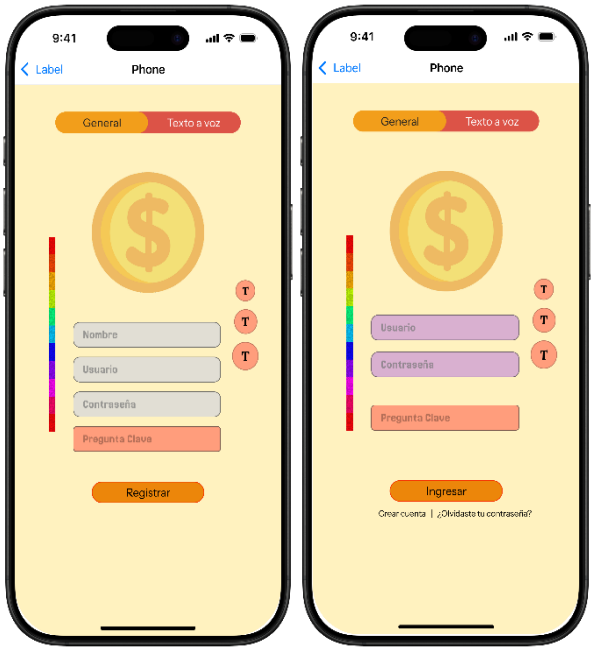
1. S1: This first option consists of a screen reader associated with people who are only color blind. This option, with 15 points, was not chosen, but may be considered for future studies.
2. S2: This second option consists of developing visual assistance software for people who are only nearsighted and astigmatic. This option, with 17 points, was not chosen, but may be considered for future studies.
3. S3: This third option consists of a financial mobile application adapted for people with visual impairments. This option, with 68 points, was chosen, and its design is being considered in this study.

4.4. Results of the Prototype Stage

In this stage, a high-fidelity prototype was developed using the Figma tool. The interface was designed to be easy to use, intuitive, and focused on flows geared toward people with visual impairments. The main features included are:

In Figure 2, section 2a shows the Create General Account interface, designed for users who provide assistance to people with visual impairments.

This screen includes registration fields, a security question, a sidebar for choosing the background colors of the interface, and a control for increasing the font size. Section 2b shows the General Login interface, which allows users to log in with their credentials, as well as recover their password or create a new account if required.



(a) **(b)**

Fig. 2 Create Account and Login General Interface.

On the other hand, Figure 3 explains auditory navigation. Section 3a shows the Text/Voice User Guide interface, which includes an audio button designed to provide guidance through spoken instructions. Section 3b shows the Create Account Text/Voice interface, which facilitates credential registration using voice commands.

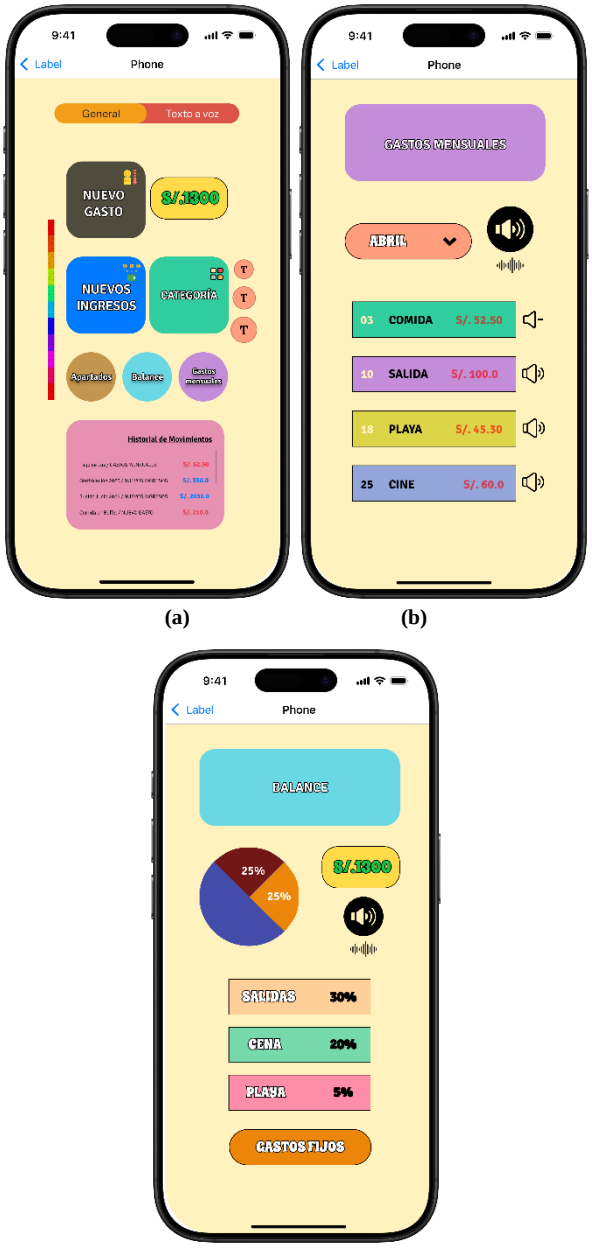
Finally, section 3c shows the Login Text/Voice, which allows voice access and includes volume controls to repeat instructions if required.

(a) (b)

(c)

Fig. 3 Create Account and Login Interface with audio.

Figure 4 contains the functional design of the system. Section 4a shows the General Menu, which provides access to the main features of the application: new expense, current balance, new income, categories, sections, balance, monthly expenses, and history. Section 4b shows the Monthly Expenses interface, which allows the user to listen to a summary of their monthly expenses by reading aloud. Section 4c shows the balance as a representation of the percentage of expenses by category.



(a) (b)

(c)

Fig. 4 Tracking Options Interface

Finally, Figure 5 shows the specific options in the main menu. In section 5a, the New Expense interface allows users to enter an expense by voice, which automatically classifies it by category through AI recognition. This comes with the option to change the category if required. Section 5b, New Income, allows users to enter financial data by voice and automatically categorize it, as well as create new categories. In section 5c, the Savings Accounts interface facilitates the declaration of savings accounts by voice and the consultation of the savings status of each one. Finally, section 5d presents the Categories interface, where the user can view existing categories and add new ones, obtaining the details of each one through voice commands.

Fig. 5 Main Menu Options Interface

4.5. Results of the Testing Stage

The prototype testing phase was developed in two complementary parts: the technical evaluation by a group of experts and the functional validation by a total of 42 users with different visual difficulties.

4.5.1. Technical Validation by Experts

In the technical review of the prototype, an evaluation was carried out by seven experts in digital accessibility, interface design, programming, and user experience (UX). Using a validated form, five aspects were assessed: intuitive navigation, auditory accessibility, visual clarity, and immediate feedback, on a scale of 1 to 5, where 1 represents "Strongly Disagree" and 5 "Strongly Agree"; the questions were closed-ended in order to obtain an objective assessment of the design, as illustrated in Table 4.

Table 4. Technical Evaluation by Expert Judgment

Criterion Evaluated	Punctuation average
The system features clear and intuitive navigation	4.7
Audio integration makes it easy for people with visual impairments	4.5
The interface design is clean and consistent	4.3
The system's responses are immediate and functional.	4.4
The prototype meets digital accessibility criteria	4.1

The results show, in general terms, a positive assessment of aspects related to auditory accessibility and navigation. On the other hand, for the quantitative evaluation, semi-structured interviews were conducted with the seven specialists about their considerations. The responses were organized by the most frequently repeated topics, which helped to identify common patterns, but also weaknesses. Table 5 presents these topics as explained by the experts, as well as the frequency with which they were mentioned.

Table 5. Qualitative Analysis of Experts

Issue Observed	Number of experts who mentioned it
Customizing speed and voice type	5
Simplification of menus and navigation paths	4
Inclusion of auditory financial reports	3
Expanded visual accessibility settings	3
Automatic voice feedback system	3

The qualitative interpretation shows that although the prototype meets the characteristics of digital accessibility, experts suggest improvements.

The main aspects that appear most frequently were the possibility of changing the speed and tone, followed by the suggestion that the navigation path be simplified to help make navigation more fluid. Other features also appear, such as income and expense reports with audio support, features that increase the functional value of the application.

4.5.2. Functional Validation by Users

Quantitative Approach

During the prototype evaluation phase, a new functional evaluation scale was carried out with 42 users with vision problems (myopia, hyperopia, and astigmatism), who rated the user experience based on the practical functions offered by the application, such as account creation and accessibility settings, balance entry and consultation, recording expenses or income by voice, entering the audio guide and navigating the menus, as well as checking the monthly balance. Each user evaluated the application on a scale of 0 to 100 in terms of perceived accessibility, ease of use, overall satisfaction, and functional usefulness, as shown in Table 6.

Table 6. Functional Validation Results

Indicator Evaluated	Average score
Hearing accessibility	91.3
Ease of use	88
Overall satisfaction	90
Usability in finance	88

The results show high satisfaction related to the system, as well as its accessibility and overall responsiveness; although the lowest score coincides with the system's usability, this indicates a need to offer more additional features; these indicators are compatible with the claims of usability and effectiveness of the system, but also suggest improving the accuracy of voice recognition and feedback in case of errors.

Qualitative Approach

During the functional validation stage, in addition to the quantitative information provided by the rating scale, some qualitative opinions were collected from participants that complemented their experience of using the application. The participants' opinions point to a positive assessment in terms of accessibility and understanding of the basic functions. Several participants stated that "the application is clear and quite easy to use". Such opinions reinforce the idea that the incorporation of this auditory component and the simplicity of the interface significantly promote user autonomy.

Other participants also highlighted the consistency offered by the visual structure of the interface linked to the auditory response, allowing them to follow the layout continuously within the interface. One participant commented that "the system maintains an understandable path between menus and functions", emphasizing the appropriateness of the design decisions taken into account in the initial prototype decisions. All of this is taken into account, as these were opinions derived from the participants themselves, who commented on expanding the voice assistant with speed and tone options, a feature that makes it easier to adapt to the different hearing conditions of users with visual impairments. Similarly, it was emphasized that for failures in accessing functions or those that do not execute completely, more obvious feedback should also be provided, such as the possibility of issuing audible notifications. In general terms, the comments received show that the system is well regarded, considering that "it is unusual for an application to be dedicated to functions without visual aids", which is in line with the inclusive approach taken in this project.

Analysis

Analyzing the results of the different stages of the study shows that Design Thinking contributes to the design of inclusive technological solutions. This is because it puts into perspective, most appropriately and coherently, the needs that arose from the design decisions that should be achieved, thus striking a balance between technical accessibility and the subjective user experience. The results, both qualitative and quantitative, verify that the prototype gives visibility to the fundamental principles of digital inclusion for a prototype that provides intuitive navigation, the possibility of adapting the interface, and the functional integration of auditory and intelligent technologies.

The evaluation by technical experts allows us to determine the adequacy of the decisions included in the prototype design and in the functional evaluation with end users, which compares the decisions in a realistic usage environment. Thus, the interdisciplinary project on accessible design and its process was validated by the dual technical and functional approach. This set of prototyping tools ensures effective, user-focused development.

Furthermore, although the results are good, there are certain limitations, such as the lack of more extensive performance tests or the sample size. However, these limitations are linked to the exploratory nature of this work and give rise to future research that will validate the prototype in broader and more varied contexts. In summary, the findings confirm that the aforementioned application represents an innovation in terms of financial inclusion for people with visual impairments. This demonstrates that it is a proposal that meets both technological and ethical and committed needs.

4.6. About the Methodology

4.6.1. Advantages

The DT method helped guide the design of the application in line with the real needs of people with visual impairments, promoting a process of creation, monitoring, and cooperation. Its organization into linked phases led to improvements in the original ideas and the creation of a functional prototype based on conditions of inclusion and accessibility.

4.6.2. Disadvantages

One of the most significant limitations of DT is that its focus is, in any case, on the formation and validation of the prototype, moving away, of course, from the technical implementation phase and performance evaluations. This

means that other methods will have to be used in possible future projects.

4.6.3. Comparison

DT provides empathy and creative problem-solving, always prioritizing the user experience over technical elements, in contrast to methodologies such as Mobile-D or Scrum. For this reason, it is particularly suitable for projects where the human aspect or access is the central focus.

4.6.4. Limitations of the Methodological Approach

The research was conducted without a large group of end users, and, as a result, it was necessary to rely on scientific data. This is not incompatible with the data collection process, but it does limit the possibility of generalizing the findings to a larger population, which should be considered for future research.

5. Discussion

During the execution of the project, some restrictions arose that limited the design approach and prototype validation; the most significant of these was not being able to work with a group of individuals who were totally blind or severely visually impaired, which would have been larger and better represented the target audience. Likewise, the lack of resources prevented the addition of advanced features such as intelligent assistants capable of remembering each user's profile or the option of linking to banking systems in real time. Nevertheless, this study provides a basis for future implementation and broader validation in different contexts.

Although this study has limitations, the results obtained contribute to the field of inclusive design through the use of Design Thinking to propose accessible solutions. This method led to teamwork that meets the needs of people with visual impairments and a continuous process of iteration, such that the Ideate and Prototype stages address the essential needs of the target audience. This feature, in participatory terms, has made it possible to create a design experience that is more consistent with the conditions experienced by users and that is in line with usability and digital design suggestions.

Unlike financial inclusion initiatives in other continents, such as Europe and Asia, where banking systems supported by auditory interfaces or integrated screen readers have been designed and implemented, this study maintains the possibility of adaptation and independence from banking platforms. This independence represents a potential advantage for implementation in Latin American countries, where the fragmentation of technologies and the diversity of technology-based devices are common barriers to the implementation and development of inclusive solutions.

On the other hand, expert judgment achieved high levels of satisfaction in the context of auditory accessibility and intuitive navigation, which demonstrates that the system itself managed to meet and satisfy the required demands; the functional test on 42 users with visual limitations due to myopia, hyperopia or astigmatism showed very positive evaluations regarding accessibility in general terms; from the analysis of the results it is evident that, without being an advance towards the final version, the prototype already served as a valid educational resource.

The qualitative analysis of expert opinions also showed potential for improvement; the changes proposed by the system allow the user to choose the voice and speed, eliminate steps in certain indices, and even include economic reports that the system reads aloud. These points align with the observations in [8]: financial inclusion stalls when technology is inaccessible and content is not adapted to it. [6] also argue that banks postpone financial inclusion to a secondary level, so a technological solution external to the banking institution becomes the support that connects what the user needs with what the banking system can provide.

From a comparative perspective, the DT methodology focuses more deeply on people's real needs, unlike methods such as Scrum or Mobile-D, which tend to overlook important aspects. [10-12] emphasize that an accessible application must undergo constant testing, ensuring that user experience, customization, and an intuitive interface are taken into account [27, 28]. In this context, this methodology has incorporated innovative features, such as the option to read income and expenses aloud, navigate the application using voice commands, and customize the screen menu for those with visual impairments. These features are uncommon in traditional banking applications.

In terms of political and social implications, the findings presented offer valuable insights for fostering better collaboration between public policymakers and the financial sector. The initiative described could serve as a model for implementing digital inclusion and financial access programs, seeking to maximize inclusion within the framework of the country's digital transformation efforts. The authors propose that financial sector regulators consider incorporating technological accessibility standards into payment platforms. In addition, they suggest creating incentives to stimulate the development of inclusive financial applications, promoting partnerships between the private sector, the public sector, and academia. It is essential to understand that digital accessibility is not only a technical issue, but also a right that ensures that all people have equal opportunities to participate in the digital economy.

Although the research may seem somewhat technical, its appeal lies largely in the balance it strikes between accessibility, usability, and design. Approaching system development from an inclusive perspective enables us to demonstrate, through user-centered design, that it is possible to achieve economically sustainable technological

development that benefits people in vulnerable situations. Similarly, it is essential to consider a methodological approach that facilitates convergence between financial technology, digital accessibility, and socially responsible design.

Finally, it should be noted that the application developed would not be an alternative to traditional banking systems, but rather a complement to them through accessible tools. In future considerations, an analytical framework could be established for evaluating interoperability with banks in real-life situations or with people who are totally or severely blind.

6. Conclusion

The main objective of this research has been to design an accessible mobile application for the financial inclusion of people with visual impairments. This research has made it possible to generate a functional prototype that meets expectations for accessibility in terms of audio, intuitive navigation, visual design customization, and real-time feedback, in addition to solving several of the technological problems faced by these individuals. The phases of the methodology have managed to bring together a potential solution that is suitable for the user, despite the fact that the number of participants was not high. Initially, the review of the documentation and the opinions of experts made it easier to obtain what the system required. Secondly, in the ideation phase, the decision was also made to create an application that would allow voice navigation, automatic reading of balances, and classification of transactions based on voice commands. The prototype built with Figma was reviewed by seven experts, who also validated that it worked and was suitable, showing high levels of agreement on the aspects evaluated.

The results obtained demonstrate that inclusive technological solutions can be developed to enable people with visual impairments to access the financial system, thereby not only involving them in the economy but also making them more independent. Although this is an initial development, i.e., a prototype, the pilot test represents an important step forward for digital equity. The conclusions drawn from the pilot test highlight certain improvements, such as a prototype with a voice option for blind people, the maturation of the advanced functionalities of a financial analysis tool, and the implementation of a direct connection to the banks' production systems. Future lines of the project may consider expanding the scope of the study with a special emphasis on validation in totally blind people or conducting institutional interoperability analyses, not only in relation to financial support tools, but also to the institutional network of banks, longitudinal trials, which are ways of enhancing the functioning and sustainability of the system in different real contexts.

Accordingly, the development of accessible solutions can benefit from including emerging technologies such as adaptive AI, haptic augmented reality, and conversational virtual assistants based on deep learning, which would enable multisensory and personalized experiences for people with visual impairments. Indeed, the inclusion of these new digital accessibility tools would be an opportunity to advance financial systems toward truly inclusive, sustainable systems that are sensitive to functional diversity.

In conclusion, it is necessary to clarify that digital accessibility is not only a technical issue, but also one of the keys to reproducing equity and social justice in a society such as today's. The designed application constitutes a first step towards a more inclusive banking environment, where technology is used as a means of autonomy and empowerment for people with visual impairments.

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