Usability Evaluation of a Mobile Exergame Application for Older Adults to Encourage Physical Activity: Mixed-Method Approach

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Abstract—Engaging older adults in physical activity is crucial for improving their health and quality of life. Mobile exergames, which combine exercise and interactive gaming, offer a promising solution to enhance physical activity among this demographic. However, the usability of such applications is a critical factor in their adoption and effectiveness. This study evaluated the usability of a mobile exergame application designed to promote physical activity in older adults, using a mixed-method approach that combined quantitative and qualitative data. A total of 33 participants aged 55 and above were recruited, primarily from the University of the Third Age (U3A) Malaysia. The usability evaluation involved remote individual testing sessions and focus group discussions to gather participant's user experience. The System Usability Scale (SUS) was employed to assess the app's usability quantitatively, while thematic analysis of focus group feedback provided qualitative insights into ease of use, functionality, and design. The results indicated high usability, with an overall SUS score of 93.4, reflecting strong user satisfaction. Participants found the app intuitive and accessible, with high task completion rates. Areas for improvement were also identified, including the need for customization options, streamlined navigation for complex tasks, and the incorporation of gamification elements to enhance user engagement and motivation. This study provides valuable insights into the design and usability of mobile exergame applications for older adults, highlighting the importance of user-friendly interfaces and personalized features. Future research suggests exploring the long-term use of such applications and adapting them for older adults with physical limitations.

Keywords- Mobile exergame app; older adults; physical activity; usability evaluation; mixed method.

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I. INTRODUCTION

Engaging in physical activity offers numerous benefits for older adults, which include improvements in physical fitness, mental health, and the prevention of chronic diseases [1], [2]. Physical activity (PA) is defined as any bodily movement produced by skeletal muscles that requires energy expenditure, encompassing a wide range of activities from structured exercise to everyday movements such as walking or gardening [3]. Despite the clear advantages of PA, many older adults remain insufficiently active. Barriers such as fear of injury, lack of information, and accessibility issues often hinder participation [4], [5]. Addressing these barriers through tailored interventions and community-based programs can significantly enhance physical activity levels among older adults, leading to improved health outcomes and quality of life [6], [7]. One example of such an intervention is mobile exergames.

Exergames, a portmanteau of "exercise" and "games," are interactive video games that require physical exertion as part of gameplay, while mobile exergames extend the concept of exergaming by allowing users to engage in physical activity through mobile applications [8]. Mobile exergames receive much attention as a tool to incorporate physical activity with interactive gaming experiences, potentially enhancing motivation and enjoyment [9], [10], [11].

Despite the potential of mobile exergames to enhance physical activity, there is a notable gap in the existing research regarding their usability and effectiveness among older adults [12]. Usability evaluation is a systematic process aimed at assessing how effectively users can interact with a system, product, or application [13]. The usability of mobile exergames is critical to determining their effectiveness and acceptance among older adults. Usability encompasses various dimensions, including ease of use, accessibility, and user satisfaction, which are essential for ensuring that older adults can effectively engage with these technologies. One study emphasized that incorporating user feedback during the design phase can significantly improve the usability of exergames for older adults, particularly those with mobility limitations [14]. While there is a growing body of research on the effectiveness of mobile exergames, there is a notable lack of comprehensive usability assessments specifically tailored for older adults.

Some studies highlight the importance of usability in enhancing user engagement and adherence, but there is still insufficient exploration of how different design elements impact the overall user experience [15], [16], [17]. Usability evaluation can help ensure that the application is accessible, enjoyable, and valuable to a broader user, potentially increasing its adoption and effectiveness in promoting physical activity [18]. To optimize mobile exergames for older populations, a more in-depth analysis of usability, including user feedback on interface design, is essential.

This study aims to evaluate the usability of a mobile exergame application designed for older adults using a mixedmethod approach to collect quantitative and qualitative data. Usability challenges are being addressed to optimize the design and functionality of the mobile exergames, enhancing physical activity levels and overall health in older adults. Insights gained from this evaluation will help optimize the applications to serve this population better, ultimately informing the development of more effective and userfriendly mobile exergames, promoting higher engagement and sustained physical activity.

II. MATERIALS AND METHODS

This study primarily aimed to assess usability through the System Usability Scale (SUS) and evaluate changes in physical activity using data collected from the mobile exergame application. The study was conducted remotely and utilized a mixed-methods design to capture both quantitative and qualitative data.

A. Study Design

A remote usability evaluation was conducted where participants individually tested the mobile exergame application, followed by focus group discussions. This study combined individual usability testing and focus group sessions to gather insights into the mobile exergame app's usability, user experience, and potential improvements. The remote setup allowed participants to engage in their own environments, which simulated real-world usage scenarios. This approach was adopted due to the COVID-19 pandemic, which necessitated remote data collection methods to ensure the safety of participants while adhering to social distancing guidelines. Conducting the study remotely allowed the research to proceed without compromising participants' health or violating public health restrictions during that period.

B. Participants

A total of 33 participants were recruited for the study, primarily from the University of the Third Age (U3A) Malaysia. The literature suggests that sample sizes of at least 20 to 50 participants are often recommended for such analyses to achieve reliable results [19], [20], [21]. This study targeted older adults aged 55 and above who had used smartphones for at least three months. Participants were required to have

access to a smartphone and a personal computer with video conferencing capabilities to join the remote sessions. Each participant used their personal mobile device to interact with the mobile exergame application from their home. This approach ensured that the usability test reflected how the app would be used in everyday life. The focus group discussions were conducted with six different groups, allowing for a broader range of experiences and insights to be gathered. The inclusion criteria also required that participants had no severe physical or cognitive impairments that would prevent them from engaging with the mobile exergame application.

C. Materials

The mobile exergame application was the primary material (see Figure 1). The mobile exergame application was installed on participants' personal smartphones, allowing them to explore its functionalities. Google Meet was utilized for both individual testing sessions and focus group discussions. Screen-sharing features were employed to observe the participant's interactions with the app in real-time. Participants shared their screens during the usability testing, and all sessions were recorded using built-in video conferencing recording features for subsequent analysis. The System Usability Scale (SUS) was used to assess the app's usability quantitatively. The System Usability Scale (SUS) is a widely recognized tool for measuring the usability of various systems, particularly in the context of software applications [22]. After completing the intervention, participants completed a 10-item SUS questionnaire, which provided insights into the app's ease of use, functionality, and user satisfaction.

D. Procedure

Participants were initially invited to join the study through WhatsApp, where they received an overview of the study's objectives and procedures. Upon indicating their willingness to participate, each participant was emailed detailed instructions. These included a request to complete the digital ethics consent form and clear guidance on installing the mobile exergame app and the Google Meet platform.

During the testing session, participants were asked to perform specific tasks within the app while sharing their screens via Google Meet. Tasks included creating an account, filling in forms, adjusting answers on the form, viewing the "Weekly Activity Log", starting and stopping exercises, setting the music and exercise type and exiting the app. The researcher observed these interactions, only intervening if technical issues arose or if the participants explicitly requested assistance. Each session was recorded for later analysis, focusing on task completion times, errors, and user feedback.

After completing the individual usability testing, each group of participants engaged in a remote focus group discussion (see Figure 2). The session began with an open discussion about participants' first impressions and experiences with the mobile exergame app. This was followed by in-depth conversations on key themes, including ease of use, functionality, design and layout, and suggestions for improvement. The specific questions used during the focus group are outlined in Table 1.



Fig. 1 User Interface (UI) of the mobile exergame app

TABLE I FOCUS GROUP DISCUSSION QUESTIONS

Items	Themes	Questions
Q1		What was your initial thought when
	First Impression	you first opened the app?
Q2	First Impression	How would you describe the look
		and feel of the app?
Q3		How easy was it to navigate through
		the app?
Q4		Were there any features or functions
	Ease of Use	that were difficult to find?
Q5		Could you complete tasks
		intuitively, or did you find yourself
		needing guidance?
Qo		What was the main function or
		feature you used in the app? How
07		Did you another any issues while
Q/	Functionality	using the app? If so what ware
		they?
08		Are there any functions you felt
QU		were missing from the app?
09		How do you find the app layout? Is
C ¹		it cluttered or well-organized?
Q10		What do you think about the color
-		scheme and the fonts used in the
	L avout	app?
Q11	Layout	Were the icons and buttons easily
		understandable?
Q12		Were there any parts of the app that
		were frustrating to use?
Q13		Can you recall any specific
		instances where you were confused
014	Improvement	while using the app?
Q14	Suggestions	If you could change one aspect of
015		the app, what would it be and why?
Q15		Are mere any reatures you would
		add to enhance your experience?

E. Data Collection

The individual usability sessions were screen-recorded, capturing participants' interactions with the mobile app. Key data, such as task completion rate, navigation errors, and any requests for assistance, were collected. The researcher took notes on specific usability issues and challenges faced by participants during testing. The focus group discussions were video recorded and transcribed for further analysis.

After completing the individual testing and focus group sessions, participants filled out the System Usability Scale (SUS) via an online Google Form. The SUS provided quantitative data on the app's usability, allowing the research team to assess participants' overall satisfaction with the app's ease of use, functionality, and design. The SUS questionnaire contained ten items rated on a five-point Likert scale (1 = strongly disagree and 5 = strongly agree), with odd-numbered items worded positively and even-numbered items negatively. The word 'system' in the original SUS questionnaire was replaced with 'Mobile Exergame,' and the word 'cumbersome' was substituted with 'complex' for this study to avoid misunderstandings.



Fig. 2 Online Focus Group Discussion Session

F. Data Analysis

The System Usability Scale (SUS) scores were calculated for each participant based on their responses to the 10-item questionnaire. The scores were summarized to evaluate the overall usability of the mobile exergame application. Each item on the SUS was rated on a five-point Likert scale, and the total scores were then converted to a range of 0 to 100, where higher scores indicated better usability. SPSS software was employed to quantitatively analyze the SUS data.

In addition to the SUS scores, task performance metrics were extracted from the individual usability testing sessions. These metrics included task completion times and completion rates, which were analyzed to determine the percentage of participants who successfully completed each task. This analysis provided insights into specific tasks where users encountered challenges or difficulties.

The recorded usability sessions were reviewed to identify key usability issues, while the focus group transcripts were analyzed using thematic analysis to uncover recurring themes, group-level insights, and suggestions for improving the mobile exergame application. The focus group feedback was thoroughly reviewed to familiarize the researchers with the content and identify initial patterns. Relevant sections of feedback were then systematically coded using descriptive phrases. These codes were further grouped into broader themes that accurately reflected the data. The themes were refined to ensure they were coherent, clearly defined, and relevant to the study's objectives. Representative quotes from participants were selected to illustrate key insights within each theme, providing rich qualitative evidence to support the findings.

III. RESULTS AND DISCUSSION

A. Overall SUS Scores

The results in Table 2 demonstrate good satisfaction with a consistent pattern of high mean scores (ranging from 4.88 to 4.94 out of 5) across most SUS items. The mean scores for negatively phrased items, the second, fourth, sixth, eighth, and tenth items, were between scales of 1.09 and 1.15, indicating that most participants disagreed with the app's negative aspects. The average percentage scores are high for all items, ranging from 89% to 97.4%. The total SUS mean score was 93.4, equivalent to a grade of "A" on the SUS score categorization grade scale (Table 3, Figure 3). Cronbach's Alpha was used to determine the strength of the relationship

between the items on each SUS scale. Items with negative wording were reverse-coded. Table 4 shows that the Alpha value is 0.708, which is greater than the standard 0.70 consequently, the SUS items in this study are considered reliable [23]. These findings indicate a high level of user satisfaction and perceived usability of the mobile exergame application among older adults. A high SUS score indicates a positive user experience, suggesting that older adults find the mobile exergame application easy to navigate and use. Research has shown that usability is a critical factor in determining user satisfaction, especially for older adults who may face challenges with technology [24]. The SUS score reflects usability and correlates with user engagement and motivation [10]. However, while these quantitative measures paint a positive picture, the qualitative feedback reveals areas for potential improvement that are not captured by the SUS alone. The details of the qualitative feedback are in the next section (see Table 6).

 TABLE II

 DESCRIPTIVE STATISTICS OF EACH SUS ITEM

#	SUS Item (N = 33)	Mean	SD	Average Score (%)
1	I think that I would like to use this Mobile Exergame application frequently	4.91	.721	95
2	I found this Mobile Exergame application unnecessarily complex.	1.15	.221	90
3	I thought this Mobile Exergame application was easy to use.	4.94	.726	97
4	I think that I would need assistance to use this Mobile Exergame application.	1.12	.630	91
5	I found the various functions in this Mobile Exergame application were well integrated.	4.88	.749	96
6	I thought there was too much inconsistency in this Mobile Exergame application.	1.12	.259	94
7	I imagine most people would learn to use this Mobile Exergame application very quickly.	4.94	.717	89
8	I found this Mobile Exergame application very complex to use.	1.09	.174	97.4
9	I felt very confident using this Mobile Exergame application.	4.94	.743	93
10	I needed to learn a lot of things before I could get going with this Mobile Exergame application	1.15	.206	91.6

TABLE III				
GENERAL GUIDELINE ON SUS SCORE INTERPRETATION				
SUS Score Grade		Adjective Rating		
> 80.3	А	Best Excelle	nt	
'68 – 80.3	3 B	Good		
68	С	Okay		
51 - 68	D	Poor		
< 51	F	Worst		
			1	
NDS.	Detractor	Passive	Promoter	
Mrs.	Not Acceptable	Marginal	Acceptable	
Acceptable:	Worst Imaginable Poor	OK Good	Excellent Best Imaginable	
Adjective:				
Grade:	F	D C	ВА	
			93.4	
SUSSCORE	0 10 20 30 40 50	60 70	80 90 100	
Fig. 3 SUS Scores and Standards				
T.B. C. Society and Daniadaus				
TABLE IV				
RELIABILITY ANALYSIS OF SUS ITEMS				

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.708	.697	10

B. Task Completion Analysis

Task completion rates are a critical performance metric that significantly influences the usability of applications, including mobile exergames. Table 5 presents the completion rate and time on task for each task performed during the usability testing of the mobile exergame application in this study. The data indicates 100% completion rates for all tasks across the seven participants, which indicates the app's overall usability. Additionally, the mean time taken to complete each task and its standard deviation (SD) provide insights into how efficiently users interacted with the app's various features. The 100% completion rate across all tasks suggests that the app's core functionalities are highly usable and accessible for the participants. This is particularly important in the context of older adults, where ease of use and task completion are critical to ensuring continued engagement with the application. The absence of task failure also highlights the app's reliability in guiding users through essential processes, such as creating accounts, filling in forms, and adjusting exercise preferences.

While the completion rates are uniform, there is some variability in the time on task across different activities. Tasks with short completion times included Task 1: Creating an account (1.30 minutes, SD 0.14), Task 2: Filling in forms (1.34 minutes, SD 0.38), Task 7: Exiting the app (1.20 minutes, SD 0.28), and Task 5: Starting and stopping exercises (1.57 minutes, SD 0.25). These tasks involved relatively simple, straightforward actions, which explains the quick completion times. The low standard deviation (SD) values suggest minimal variation in task performance between participants, indicating that these tasks were consistent and intuitive for all users.

On the other hand, tasks with longer completion times were Task 4: Viewing the "Weekly Activity Log" (3.22 minutes, SD 1.13) and Task 6: Setting the music and exercise type (3.59 minutes, SD 0.96). These tasks likely involved multiple steps or required users to navigate through various app features, resulting in longer task durations. The higher SD for Task 4 indicates greater variability in user performance, suggesting that some participants may have experienced more difficulty completing this task than others. Tasks involving multiple steps or requiring customization (such as Task 6) naturally took longer to complete. While the longer completion times do not necessarily indicate a usability issue, they highlight tasks that may benefit from more streamlined workflows or additional guidance for users, particularly for older adults who may find customization tasks more challenging.

The low SD values for most tasks suggest that the app provided a consistent user experience across participants. This consistency is crucial for ensuring that the app meets the needs of a wide range of users, including those who may not be as familiar with mobile technology. The high completion rates and generally short time on task for most activities demonstrate that the mobile exergame app is both intuitive and user-friendly. The slight increase in task time for more complex activities, such as viewing the activity log and adjusting music settings, suggests areas where workflow streamlining or additional guidance could further improve usability, particularly for older users. However, the overall results indicate that the app facilitates key user interactions and provides a consistent and accessible user experience. Users who complete tasks tend to make fewer errors, which contributes to a more efficient and satisfying user experience [25], [26].

 TABLE V

 COMPLETION RATE AND TIME ON TASK PER TASK

Task	Time per task (min) Mean (SD)	Completion Rates (%)
Task 1 Creating an account	1.30 (0.14)	7/7 (100)
Task 2 Filling in forms	1.34 (0.38)	7/7 (100)
Task 3 Adjusting answers on the	1.60 (0.32)	7/7 (100)
form		
Task 4 Viewing the "Weekly	3.22 (1.13)	7/7 (100)
Activity Log"		
Task 5 Starting and stopping	1.57 (0.25)	7/7 (100)
exercises		. ,
Task 6 Setting the music and	3.59 (0.96)	7/7 (100)
exercise type		
Task 7 Exiting the app	1.20 (0.28)	7/7 (100)

C. Focus Group Discussion Feedback

The focus group discussions revealed key insights into the participants' experiences and provided rich qualitative data that supplemented the quantitative findings. Feedback was organized into five primary themes: First Impressions, Ease of Use, Functionality, Design and Layout, and Improvement Suggestions.

1) First Impressions: Most participants had positive initial reactions to the app, describing it as "clean and inviting" (P1), "very professional" (P2), and "appealing with bright colors and large text" (P3). These remarks suggest that

the app's visual design was well-suited to its target audience, particularly older adults. However, some participants noted that the app "feels a bit cluttered" (P4) and that the setup process was "a bit lengthy" (P5), pointing to potential improvements in first-time user experience.

2) Ease of Use: Navigation was generally perceived as straightforward, with comments such as "navigation is simple and easy" (P1) and "most features are easy to follow" (P14). However, some usability issues were identified, such as difficulty finding the main page (P3) or hidden settings (P2), which occasionally confused. These findings align with the task completion rates, where more complex tasks require additional effort.

3) Functionality: The app's core functions were positively reviewed, including exercise tracking and symptom reporting. Feedback such as "instructions are clear and simple" (P2) and "good integration with tracking" (P15) indicated that the app generally performed well. Nonetheless, some participants reported technical issues, including "frequent app crashes" (P5) and "the game is slow and lagging" (P1), suggesting that the app's performance could be improved to ensure a smoother user experience.

4) Design and Layout: The app's design was wellreceived, with participants noting that the large buttons and clear instructions were especially useful for older adults (P5, P9). However, there were suggestions for improvement, such as making some buttons larger (P4) and improving the overall layout to feel less cluttered (P3). These suggestions indicate that while the app's visual design was effective, further refinement could enhance its accessibility and usability.

5) Improvement Suggestions: Participants provided valuable suggestions for enhancing the app's functionality and engagement. Many participants requested additional customization options for exercises (P1), more game modes (P6), and features like social components to compete with friends (P7). Other suggestions included adding a reward system to motivate users (P4) and integrating advanced fitness metrics tracking (P22). These insights highlight the desire for a more dynamic and customizable user experience that could sustain long-term engagement.

TABLE VI
PARTICIPANTS' FEEDBACK

First Impressions	Ease of Use	Functionality	Design and Layout	Improvements
"The app looks clean and inviting."-P1	"Navigation is simple and easy."- P1	"The game is a bit slow and lagging."-P1	"Layout is clean, but some text overlaps on smaller screens."-P1	" Maybe we can put a few exercise options. Having options makes it easier to stay consistent." -P1
"Very professional appearance, but took a while to load."-P2	"Easy to find most features, but settings are hidden."-P2	"Instructions are clear and simple. It is good. No complicated"-P2	"Good contrast and font size, icons not confusing." -P2	" Memory games can be a nice addition. It's not just about moving; it will challenge my brain too. " -P2
"Bright colours and large text, very appealing."-P3	"Sometimes I cannot find the main page."-P3	" Login process is too lengthy and complicated."- P3	"Icons are intuitive, the colour scheme is a bit overwhelming." -P3	"Include more customization options"-P3
"Looks modern but feels a bit cluttered."-P4	"It's hard to navigate without using the back button frequently."- P4	" Maybe integrating the exergame with a smartwatch can provide a more comprehensive view	"Design is modern, but some buttons are too small." -P	"Reward such as coupon may be good." -P4

First Impressions	Ease of Use	Functionality	Design and Layout	Improvements
		of our activity and health "- P4		
"Sleek design but initial setup was a bit lengthy."-P5	"Finding help was difficult when needed."-P5	" Frequent app crashes."-P5	" The instructions and large buttons are great. They're easy to see and follow " -P5	" I prefer something calming, like stretching, and other times, I want something more dynamic. Having options is great." -P5
"Clean interface with a nice balance of colors." – P15	"Menus are well- organized, but some icons took time to find." - P6	"Everything works well, but more game modes would be a bonus." – P7	"Nice design - P6	"More feedback on progress, like milestones, would boost motivation." – P6
"I liked the colors, the initial experience was smooth." - P7	"The layout is easy to follow" - P7	"Features work well, but sometimes a little slow to respond." – P9	"The buttons are easy to use, but larger ones would be even better." – P16	"Adding a social component, like competing with friends, would be fun." – P7
"It's visually appealing, very engaging." - P8	"Once I got used to the app, navigating it was very easy." – P10	"Minor lag when switching between activities, but overall smooth." – P11	"The layout is clear." - P8	"More activities for different fitness levels would be a welcome addition." – P24
"The app's interface is clean and straightforward." – P11	"Most features are easy to find" – P14	"Good application." – P12	"Simple design, easy to understand"- P9	"Adding language options would be helpful for non- native speakers." - P9
"Setup was easy, the interface looks good overall." - P14	"Navigation was mostly intuitive"- P15	"I like how the visual data presented. Easy to understand" - P20	"The layout is simple and clean, but more color variety would be nice." - P15	"No notification is good because I don't like notification" - P18
"The app is user- friendly and easy to understand." – P22	"Navigating the app was smooth after using it for a while." - P17	"Most exercises work fine, though some were repetitive." - P16	"Text is readable, but the layout could be more dynamic." – P17	"More variety in exercise types would improve the experience." – P21
"Good initial impression, the colors and layout look good." – P27	"The navigation is very easy to understand" – P25	"The instructions were helpful." - P17	"Most buttons were fine, but a few could be a bit larger." - P12	"Offering more difficulty levels would cater to different fitness levels." - P10
"Overall, a positive first impression, but it could be more engaging." – P29	"The main features were easy to find." – P33	"Exercises are generally good, but some could be more challenging." – P23	"The interface is fine, but more creativity would make it better." – P30	"Tracking more advanced fitness metrics would be helpful." – P22

D. Usability Challenges and Potential Improvements

The mobile exergame's User Interface (UI) received generally positive feedback from participants regarding its clean design, good contrast, and readability. However, several areas of improvement were noted, particularly in relation to the clarity and usability of the interface for older adults.

1) User Interface (UI) Improvements:

The importance of User Interface (UI) design in mobile exergame applications for older adults is underscored by several factors, including usability challenges, cognitive and motor demands, and the need for engagement and motivation in physical activity [27]. Older adults often face age-related changes that affect their cognitive and motor skills, so a well-designed UI can significantly enhance their interaction with mobile exergames, promote physical activity, and improve overall health outcomes. A thoughtfully designed UI can help mitigate these challenges by providing clear instructions, intuitive navigation, and feedback mechanisms that guide users through their interactions [28].

Some participants expressed difficulties with button sizes, describing them as "too small". For older adults users, larger buttons and more prominent icons are essential for accessibility, especially for those with reduced dexterity [29].

Increasing the size of interactive elements would make the app easier to use, particularly for participants who struggle with fine motor skills [30], [31], [32].

A few participants noted that the icons were "a bit overwhelming". Reducing the number of icons on the screen and ensuring they are easily distinguishable could help simplify the interface and make navigation more intuitive. This would also reduce cognitive load, enabling users to focus on key tasks without becoming confused by too many options [33].

Several participants suggested adding customization options, such as the ability to change the color scheme or font size. Allowing users to personalize the app's appearance would not only cater to individual preferences but also improve accessibility for users with varying visual needs [34].

2) User Experience (UX) Improvements:

User Experience (UX) is a critical aspect of mobile exergame applications for older adults, as it directly influences their engagement, satisfaction, and overall effectiveness in promoting physical activity. A well-designed UX can enhance usability, reduce barriers to participation, and ultimately contribute to better health outcomes for older adults [14].

In addition to UI enhancements, focus group feedback identified several areas where the user experience (UX) could be improved, particularly regarding navigation, functionality, and engagement. While many participants found the app "easy to navigate" (P1) and "simple to use" (P2), there were notable challenges that could be addressed to optimize the overall experience.

Although most users reported that the app was easy to navigate once they became accustomed to it, several participants encountered initial challenges, especially when locating certain features, such as the main page (P3) or hidden settings (P2). This indicates a need for more intuitive navigation pathways, such as clearer labeling or adding tooltips to guide users through unfamiliar features. Introducing a step-by-step tutorial or guided onboarding process for first-time users would also reduce the learning curve and help users feel more confident when using the app [35].

Additionally, users recommended implementing a reward system, where they could earn incentives such as coupons or points for completing certain tasks (P4, P13). Introducing these features would add a gamification element to the app, encouraging users to stay active and making the overall experience more enjoyable and rewarding [36], [37], [38].

By implementing these UI and UX improvements, the mobile exergame app can enhance its accessibility, usability, and overall user satisfaction, ultimately supporting older adults in maintaining an active lifestyle.

E. Contribution to the Literature

This study significantly contributes to the literature on UI/UX design for mobile exergame applications targeting older adults by addressing key usability challenges and providing practical recommendations for improving user interface and user experience. The findings emphasize the importance of large, accessible buttons, clear icons, minimal clutter, and critical UI elements to ensure ease of use and reduce cognitive load among older adult users. Additionally, the study highlights the value of customization options such as adjusting font size and color schemes, allowing users to tailor the interface to their specific needs and preferences, thereby enhancing accessibility and comfort. On the UX side, the research underscores the need for streamlined onboarding processes with step-by-step tutorials to help older adults overcome the initial learning curve, along with simplified task flows for complex actions like setting preferences and adjusting settings.

The study also suggests incorporating gamification elements, such as rewards and social interaction features, to increase engagement and motivation. By focusing on both UI clarity and UX engagement, the study contributes to the development of more inclusive, intuitive, and engaging digital health tools better suited to older adults' cognitive and physical needs.

IV. CONCLUSION

This study evaluated the usability of a mobile exergame application specifically designed for older adults, providing valuable insights into the app's User Interface (UI) and User Experience (UX) aspects. The findings demonstrated high usability and ease of use, as reflected by a positive System Usability Scale (SUS) with a mean score of 93.4, equivalent to an "A" grade, and high task completion rates. Older adults found the app's features, such as large buttons, clear icons, and minimal navigation complexity, to be accessible and easy to navigate, essential for ensuring engagement and continued app use.

However, the study also highlighted areas where improvements could be made. Participants suggested enhancing the app's customization features, particularly for adjusting font sizes and colors, to meet individual needs better. Additionally, there were some challenges with multi-step processes, such as adjusting exercise settings and viewing the weekly activity log, suggesting that more streamlined navigation and guided onboarding could improve the user experience, particularly for first-time users.

The research also underlined the importance of incorporating gamification elements and social interaction features, such as reward systems and social competition, to engage users further and promote long-term physical activity. These features could increase motivation and adherence to the app, fostering a more enjoyable and sustained user experience.

In conclusion, the study provides a strong foundation for future development of mobile exergames for older adults. By addressing the usability challenges identified in this study such as improving navigation, offering more customization options, and integrating social and motivational features—the app has the potential to become an effective tool for encouraging physical activity among older adults.

Future research could explore how the mobile exergame application can be adapted for older adults with limited mobility or physical disabilities. Since the current version of the app primarily targets older adults capable of performing physical exercises, modifications could incorporate lowerimpact or seated exercises. Studying the usability and effectiveness of the app in this specific demographic could broaden its applicability and improve engagement among a wider range of older adults.

While this study provides insights into short-term usability, long-term studies are needed to evaluate sustained user engagement with the mobile exergame app. Research could focus on how users interact with the app over extended periods, for instance, 6 months to a year, to understand factors influencing continued use and long-term health outcomes.

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