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DESIGN AND USABILITY EVALUATION OF A BILINGUAL (URDU/ENGLISH) CHILD MONITORING APP FOR LOW-LITERACY PARENTS

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Article Info

Abstract

This study addresses the accessibility challenges of child monitoring for illiterate and semi-literate parents by developing and evaluating a bilingual (Urdu/English) application. The system integrates voice-guided navigation, culturally intuitive icons, real-time GPS tracking, SOS alerts, and social media monitoring to support low-literacy users. A controlled usability study with 20 participants (10 illiterates, 10 semi-literate) compared Urdu and English interfaces on task success rates, completion time, and error frequency. Results showed that Urdu interface users achieved 35% higher task success rates and completed tasks 40–50% faster than English interface users. Qualitative feedback highlighted that voice guidance enabled independent task execution and improved comprehension of monitoring features. These findings demonstrate the critical role of culturally and linguistically adaptive design in parental control technologies. The study offers a replicable framework for developing inclusive monitoring solutions that bridge literacy gaps, ensuring equitable access to child safety tools across diverse populations.

Keywords: *Human Computer Interaction, Usability Evaluation, Urdu/English User Interfaces, HCI4D, GPS Tracking, SOS Alerts*.

Introduction:

Digital devices have been adopted amongst children at a fast pace and there are growing concerns with regard to their safety in both the online and offline space [1]. While smartphones, tablets and other connected technologies give children access to information and social interaction in ways never before experienced, they also introduce them to challenges like inappropriate content or cyberbullying, and unsupervised usage of apps [2]. It is therefore essential that parents are involved and have the ability to oversee these activities effectively, but parents who are not highly literate have many difficulties in doing so. Most traditional parental control programs, such as Google Family Link and Secure Teen, use a text-based interface, making them inaccessible to users that don't know how to read and write. [3].

There has been prior work in other application areas, such as the e-commerce, healthcare and employment sectors, that has shown that voice guided and icon based interfaces can in fact significantly enhance the usability of low-literacy populations by Human Computer Interaction for development(HCI4D) [4]. While great strides have been made, there are still some aspects of designing child monitoring applications that are underdeveloped and not considered, such as providing bilingual or culturally adapted interfaces and catering to the needs of parents who lack literacy skills. This space is a problem in terms of accessibility and equitable child safety because this vulnerable group is not receiving adequate technological assistance. [5]

Current parental monitoring solutions are not inclusive and accessible to parents who are illiterate or semi-literate, which prevents them from monitoring their children's online usage. Interfaces that have too much text, that are not supported in local languages and that are not culturally relevant compound it. There is a definite need for an easy-to-use, bilingual, culturally sensitive answer that can overcome the literacy barrier and still provide full monitoring capabilities. [6]

Although there have been some systems that have explored voice control and/or icon control for low-literacy users in healthcare, e-commerce and education contexts, there is a lack of empirical studies in the child monitoring technology domain using voice control and/or icon control. In particular, no study has been conducted to compare the effectiveness of bilingual interfaces (Urdu/English) in real usage situations for illiterate and semi-literate parents. Furthermore, current tools rarely combine several monitoring features, like GPS tracking, SOS emergency calls, and social media monitoring in a unified tool designed for low-literacy users. [7]

This study aims to fill those gaps and design and evaluate a bilingual (Urdu/English) child monitoring app for parents with low literacy levels. The application includes three important features designed to improve the usability and accessibility of the application:

1. Dually language interfaces with voice guidance, whereby parents can use the interface without needing to read the text.
2. Progressive disclosure, culturally intuitive icons, and minimalist interface to keep the cognitive load low but allow full functionality.
3. Seamless monitoring systems like GPS tracking, emergency SOS help, and social media supervision, offering thorough child security.

The Urdu interface was found to be superior to the English interface in terms of task achievement and response time in a controlled usability assessment with 20 participants, half of whom were illiterate and half were semi-literate parents. The results clearly indicate that native-language voice guidance works well to overcome literacy gaps.

This study introduces a practical approach to designing culturally responsive, low-literacy supportive child monitoring technologies, with design principles for building culturally responsive, low-literacy applications. This work merges linguistic accessibility, culturally-informed design, and a built-in monitoring feature to provide a replicable blueprint for expanding an inclusive digital solution to underserved populations [8]. The proposed bilingual child monitoring application not only overcomes accessibility problems of low literacy parents but also incorporates a comprehensive range of safety features as shown in Figure-1 above.

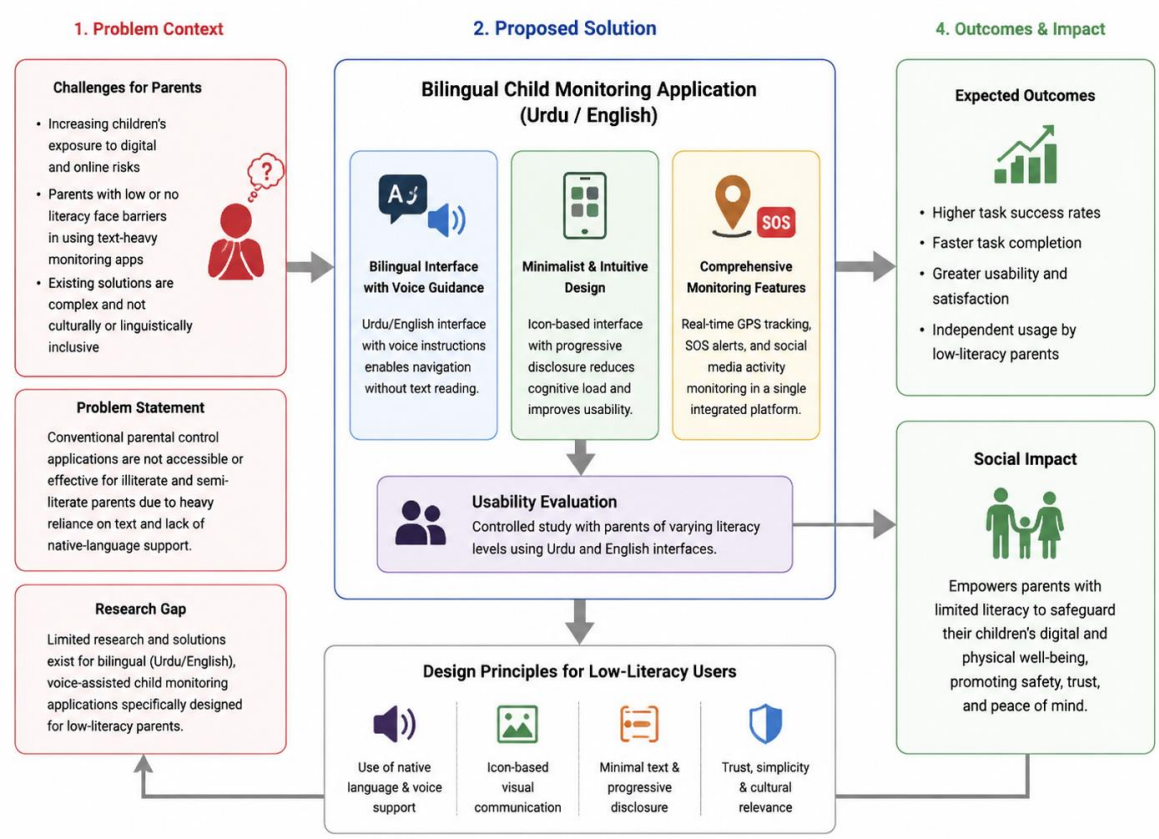

Fig. 1. Conceptual Framework of the Bilingual Child Monitoring Application for Low-Literacy Parents.

2.Related Work:

In recent years, there has been a great deal of research on parental control and child monitoring technologies, given the concerns about children's safety both online and offline. In addition to their technical capabilities, the usability, cultural relevance and the literacy level of users are also important factors in adoption of such applications through Human Computer Interaction (HCI).

Previous research has shown that the design of the interface, the number of features, and the ease of navigating around the application have a significant effect on parental involvement in monitoring applications [9].

The majority of traditional child tracking solutions are based on location tracking with GPS and messaging through the cloud. For example, geofencing is a mobile system and integrates with the GPS and GPRS technologies, which enables real time supervision and monitoring; a mobile app will alert parents when their child enters or exits a safe location. Wearable technologies (e.g. activity tracker for children under 13) are also possible though research has highlighted issues such as low feedback, usability and difficulty interpreting data from the app [10]. The findings demonstrate the need for functionality and usability, especially among those with low literacy levels.

There are many studies that have addressed the usability problems of non-literate or semi-literate people. It has been shown that interfaces with pictorial icons and voice direction and with limited text input will significantly improve usability for low-literacy users in eCommerce, health and education fields [11]. Furthermore, the effectiveness of task completion, efficiency, and user satisfaction is much greater if the modes of interaction are not textual, but rather speech, visual clues and audio feedback. Culturally informed, linguistically adaptive design has worked in other situations, for people with low levels of literacy when using online shopping apps, first-aid apps, and mobile banking apps. [12].

In addition to their technical usability, researchers have also studied social and developmental considerations of parental monitoring instruments. Research on adolescent online safety with value sensitive design also shows the importance of maintaining a balance between parental control and adolescent autonomy and privacy, underscoring the role that design choices in the interface of electronic resources play in a family's dynamics, not just their functionality [13]. A detailed look at the features of the commercial parental control applications also shows that there is a level of granularity in the levels of restriction, lack of transparency on feedback provided and communication support, which can impact the usefulness, trust and engagement of the users. [14]. The results of this study highlight the need for technically suitable and socially sensitive monitoring systems.

Even with these developments, there are two main areas in the literature that are lacking. First, there has been no application of child monitoring that covers the full range of functionality and accessibility for low-literacy users, especially parents who find it hard to read text-based instructions. [15]. Secondly, inclusive interface design principles including voice guidance, bilingual support, culturally sensitive icons etc. are not often used in the context of child monitoring technologies. A significant majority of studies are still of a limited scope and concentrate on a specific field such as healthcare, e-learning, or financial applications and thus have little direct relevance to parental control applications. [16].

This study seeks to address these gaps by creating a voice-directed, bilingual (Urdu/English) child monitoring application that combines real-time GPS tracking, emergency messaging, and social media monitoring all in a single app. [17]. The study's findings demonstrate how to enhance usability of the system through inclusive Human-Computer Interaction (HCI) theory and culturally

responsive design, offering empirical evidence to support these improvements for parents who are illiterate and semi-literate.[18]. This does not only improve task efficiency and success; it creates a replicable framework for building monitoring technologies for use at low levels of literacy in other cultural contexts [19]. A summary of some representative studies on parental control and low-literacy interface design is shown in Table I, and the properties, target audience, interface kind, language support, and limitations of previous research are indicated. The table shows the lack of access and bilingual support and highlights how the proposed bilingual child monitoring app will help fill that gap.

TABLE I: Comparative Summary of Related Work on Parental Control and Monitoring Applications

Study / System (Year)	Focus / Domain	Target Users	Key Features Addressed				Key Limitations
			GPS Tracking	Activity / Screen Monitoring	Voice / Audio Guidance	Bilingual / Native Language	
Elkhowiter et al. (2017)	Parental control apps (Google Family Link)	General parents	✓	✓	—	—	• Text-heavy, English-only • Not suitable for low-literacy users
Kemeny (2017)	SecureTeen application	Tech-savvy parents	✓	✓	—	—	• Complex interface • No accessibility features
Rahman (2019)	Voice-guided e-commerce systems	Illiterate & low-literate adults	—	—	✓	✓	• Domain limited to shopping • No child monitoring features
Xie (2017)	Icon-based mobile interfaces	Low-literacy users	—	◑	—	—	• Basic interaction only • No real-time monitoring
Khan et al. (2016)	Voice interfaces for healthcare	Low-literate patients	—	—	✓	—	• Single-function systems • Not designed for parents
Recent HCI4D Studies (2020–2023)	Bilingual / inclusive mobile apps	Low-literate populations	◑	◑	✓	✓	• Limited evaluation in child monitoring context
Proposed System (This Work)	Bilingual child monitoring app	Illiterate & semi-literate parents	✓	✓	✓	✓	✓ Integrates **all core monitoring** features ✓ **Urdu/English with voice guidance** ✓ Empirically evaluated with low-literacy parents ✓ Optimized for **usability & accessibility**

Legend: ✓ = Fully Supported ◑ = Partially Addressed — = Not Addressed ✓ = **Enhanced in This Work**

3.System Design

The child monitoring application is created with the goal to help mothers and fathers manage their kids, no matter their literacy or semi-literacy, in an inclusive and easy to use way. The system is simple and easy to use, and it has good features, which can be used to monitor the children's digital and physical activities, even by those with limited technical skills. There are two modes of operation: Parent Mode and Child Mode that are used to perform specific tasks with an intuitive user experience. [20]

3.1 Architecture Review

The application uses a client-server technology to enable real-time communication between the device of the child and the parent interface. Child Mode automatically downloads the app onto the child's device and gathers behavioral and usage information (such as GPS locations, app usage, screen shots, and communication records). Internet access is intermittent so data is stored locally and synced to the cloud through an internet connection, as needed, for continuous monitoring. Parent Mode: The interface is used as a control hub; it fetches and shows the child's data on a visually appealing, multilingual interface[21]. The platform features voice guidance, Urdu and English support, culturally relevant icons, particularly designed for low-literacy users. All data can be accessed remotely and securely through the cloud, and can be consistently and reliably monitored. This Figure-2 displays how the data is passed from the child application to the parent application and then to the various other modules, such as local storage and online storage. The user interaction, events and emotion prediction information are processed to provide real-time monitoring, notifications and predictive information, reflecting the integrated architecture of the proposed bilingual child monitoring system. [22]

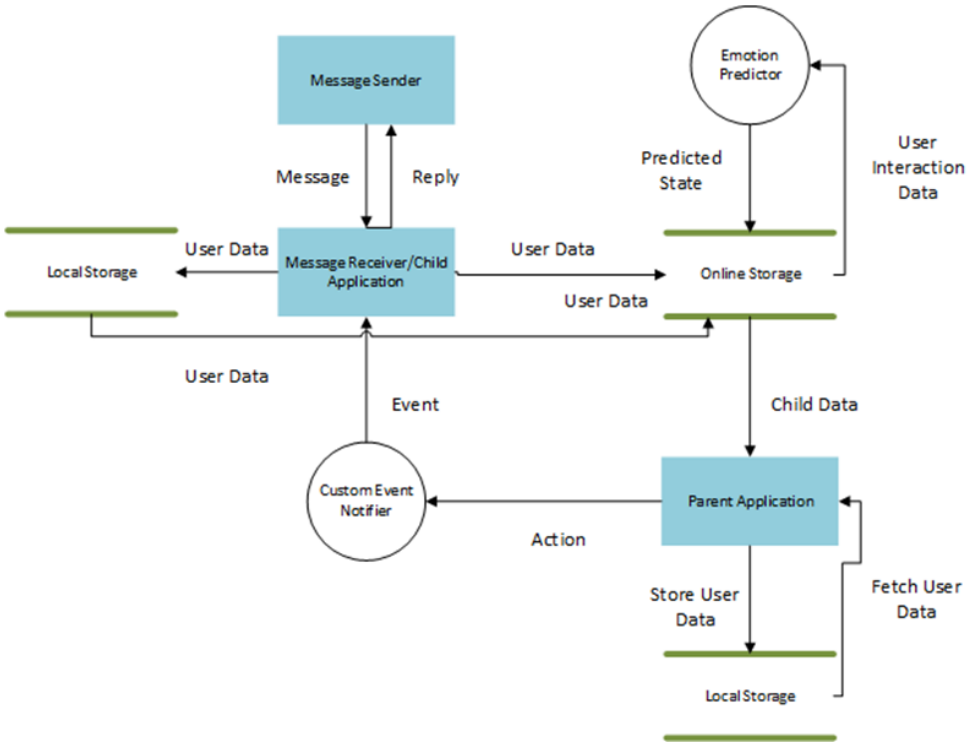

Fig2. Workflow of Application

3.2 Key Functionalities

The application has a few key components to ensure full child supervision. It utilizes GPS and geofencing, with real-time location tracking, to alert parents when their kids venture outside of safe zones. Screen monitoring captures screenshots at regular intervals, so Parents can see what is being done on the device, and call and message logs log SMS and call activity for monitoring. In addition, the system features social media monitoring to identify potential dangers on major platforms and an SOS emergency feature that allows kids to alert parents with a single tap of a button, including their location. The interface is voice guided and bilingual (Urdu/English) instructions, so that it is easier to access and less reliant on text; enabling low-literacy parents to use the application independently and confidently.

3.3 User Interface and Usability

The interface employs a minimalist, icon-driven design to reduce cognitive load. Audio prompts guide users through tasks, while flat navigation structures prevent confusion from deep hierarchical menus. [23] Icons and interface metaphors are culturally familiar, enabling low-literacy parents to interact efficiently and confidently. This Figure-3 shows the login interface of the bilingual child monitoring application, featuring Urdu/English language selection, user role selection (parent/child), and avatar-based options for personalized identification.

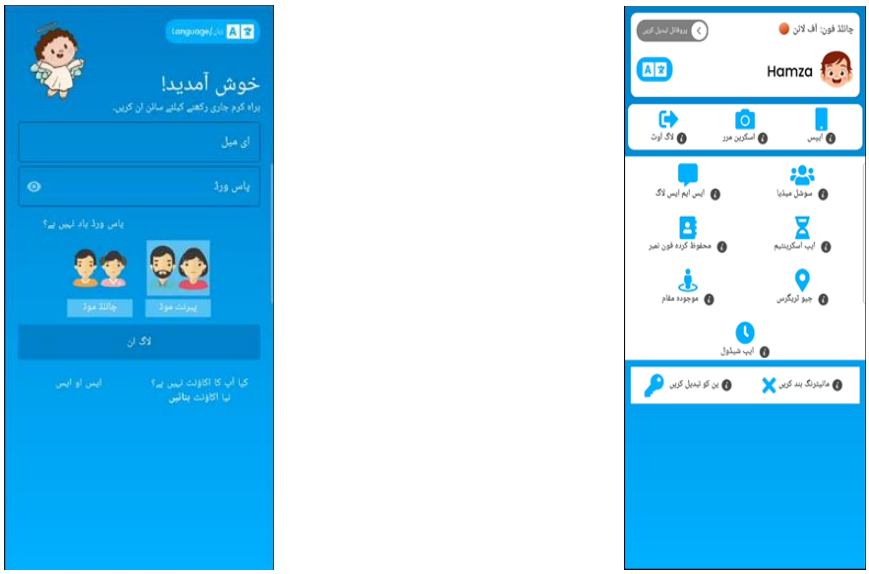

Fig-3. Left to Right: Login Page, Home Screen

3.4 Security and Privacy Measures

The application has been designed with various security protocols to safeguard the safety and privacy of its users. Child-side operations execute in stealth mode, meaning that monitoring is done in stealth mode and there is no risk of tampering or unintentional disenable. The parent side

features sensitive functions, which are secured by PIN authentication, to allow only authorized users to access the critical functions. Furthermore, child-to-server and server-to-child transmission of data is encrypted, ensuring privacy and security of all data transferred between the devices and the cloud server, which is the personal information of children and parents. [24]

3.5 Technical Implementation

The application is created using Android, Firebase is used for cloud storage, real time sync and user authentication. It incorporates Google Maps API to track the location and makes use of the Android Accessibility Services to make sure that app use is tracked without being obvious. [25] Furthermore, the system is modular and scalable, enabling the expansion of its capabilities and integration with other monitoring functions in the future without significant impact on usability and performance.

4.Usability Evaluation

The approach in this study was structured for assessing the usability of a bilingual (Urdu/English) child monitoring app for parents with different levels of literacy. Both experimental design and participatory observation were employed in the data collection of quantitative and qualitative data concerning task performance and the interaction among users. The methodology was designed to ensure that the study could be replicated, was ethically correct and was relevant to the target population being studied. [26]

4.1 Participants

Twenty parents were involved in the study which was equally divided between illiterate and semi-literate. Randomization was done into two groups to test the Urdu and English interfaces [27]. All parents in the study were parents of children aged 6-12 years and had limited prior experience with digital parental control applications: Group 1 (Urdu interface) consisted of 5 illiterate parents and 5 semi-literate parents, Group 2 (English interface) consisted of 5 illiterate parents and 5 semi-literate parents. The study was performed after ethical approval by the appropriate institutional review board and informed consent was secured from all the participants before the evaluation.

This table summarizes the study participants, including literacy level, interface group assignment, and age range. It provides a clear overview of the sample for Section 4.1 (Participants).

Group	Interface Language	Literacy Level	Number of Participants	Age Range
1	Urdu	Illiterate	5	25–40
1	Urdu	Semi-Literate	5	27–42
2	English	Illiterate	5	26–38
2	English	Semi-Literate	5	28–44

Table 2: Demographic distribution of participants by interface and literacy level.

4.2 Study Design

A controlled usability test was carried out to test the Urdu and English interfaces. Each participant was given a standardized set of tasks representing typical parental monitoring activities and was guided from simple tasks to key emergency scenarios. The most important functions were: search and access to the child's profile, view of the current location of the child and SOS function [28]. This systematic approach enabled the evaluation of the routine and high-stakes functions of the interface which led to the accurate evaluation of the interface's usability based on the various levels of literacy.

4.3 Data Collection

Quantitative data were gathered to assess the success rate in completing the tasks, the time taken to complete the tasks, and the frequency of errors made, to gauge objectively, the performance of the interface. Further, qualitative observations were documented to observe how participants interacted with the App, such as hesitation, use of audio cues, understanding of visual icons, etc. From those observations, it was possible to determine the patterns of usability and the difficulties encountered by the users that could be used to improve the usability of the software in the future. [29]

This table presents quantitative results showing that participants using the Urdu interface had higher success rates for all tasks, highlighting the impact of native-language support on usability.

Task	Urdu Interface (%)	English Interface (%)	Performance Gap (%)
Open Profile	95	60	+35
Check Location	90	55	+35
Send SOS Alert	85	50	+35

Table 3: Comparison of task success rates between Urdu and English interfaces.

This table shows that participants using the Urdu interface completed tasks faster, demonstrating improved efficiency and reduced cognitive load compared to the English interface.

Task	Urdu Interface (s)	English Interface (s)	Time Saved (s / %)
Open Profile	25	48	23 (48%)
Check Location	30	55	25 (45%)
Send SOS Alert	20	40	20 (50%)

Table 4: Average time to complete tasks for Urdu and English interfaces.

This table summarizes error occurrences for each task, highlighting the challenges faced by low-literacy users with the English interface and demonstrating the advantage of the Urdu voice-guided interface.

Task	Urdu Interface	English Interface	Observations
Open Profile	2	8	Errors in English group due to text-heavy screens
Check Location	1	7	Hesitation and mis-clicks more common in English group
Send SOS Alert	1	9	Text-based confirmation caused delays in English group

Table 5: Distribution of errors across tasks and interfaces.

As shown in Figure 4, the Urdu interface yielded higher task success rates across all tasks, reinforcing the quantitative findings presented in Table 3 This bar graph illustrates the task success rates for three core usability tasks: Open Profile, Check Location, and Send SOS Alert. Participants using the Urdu interface consistently achieved higher success rates compared to the English interface, with an average improvement of approximately 35%, highlighting the effectiveness of bilingual voice guidance in enhancing usability for low-literacy parents.

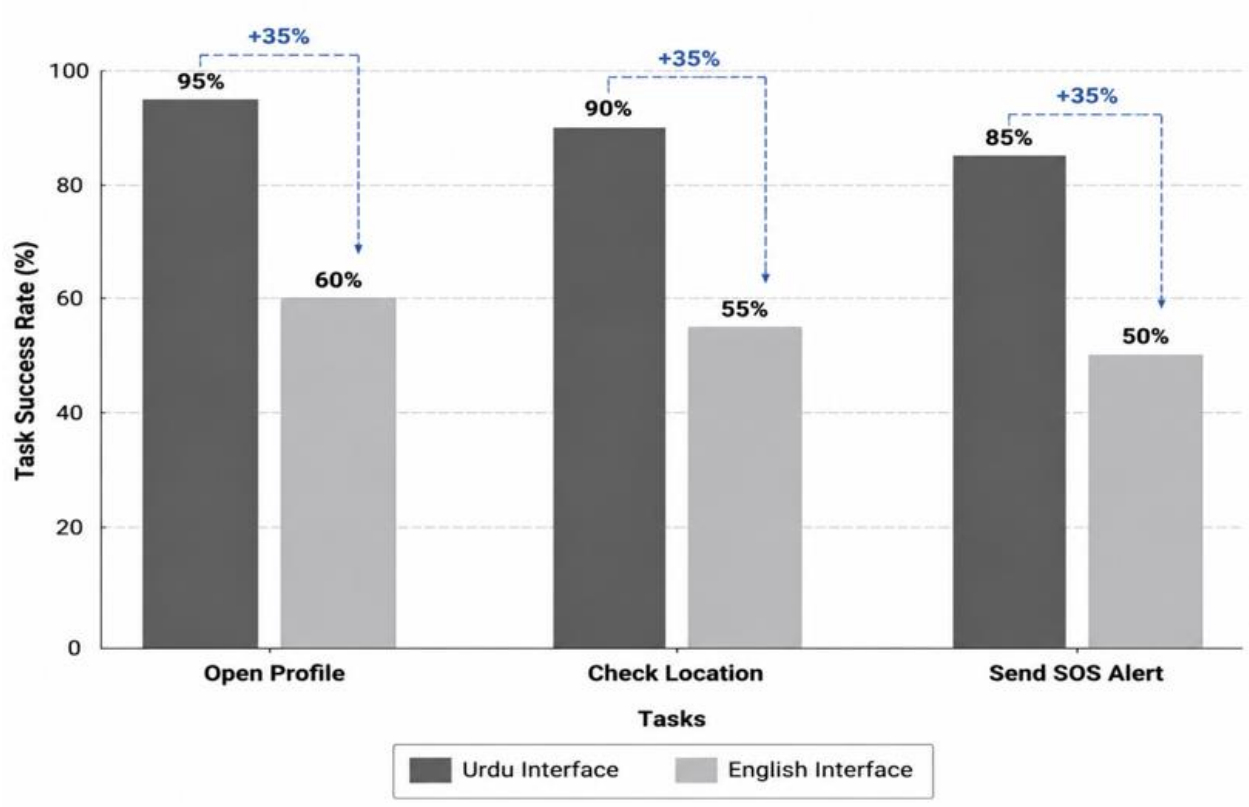

Fig-4 Comparison of Task Success Rates Between Urdu and English Interfaces

4.4 Procedure

Each participant was asked to use the given interface without any training. The explanation of each task was given verbally, and the participants were observed as quietly as possible to reduce experimental bias. [30]. The app included audio cues to help with completion of the tasks, and time to complete, successful completion, errors and misunderstandings were recorded for each task. After finishing the tasks, participants also gave subjective comments about the usability, the ease of navigation and language interface preference, which were analyzed and added to the quantitative results. [31]

4.5 Data Analysis

Descriptive statistics, such as mean task completion times, task success rates and error distributions, were used to analyse quantitative metrics. Urdu and English interface groups were compared to identify the effect of the support of native language on usability [32]. Qualitative feedback was analysed thematically, to identify common barriers, preferences and benefits of voice-enabled, bilingual interfaces for low-literacy parents.

4.6 Limitations

This study has several limitations. A small number of participants (20) and the targeting of a certain demographic and geographic region may impact the generalizability of the results. On the Android platform, only Urdu and English interfaces were assessed, and the usability was assessed in a single session only and there was no adoption data. Further, only the three core tasks profile access, location checking and SOS alerts were evaluated while other real world monitoring scenarios were not tested.

5. Conclusion and Future Work

A usability evaluation has shown that voice output of native language is effective on bilingual interfaces. The guidance greatly improves the accessibility and effectiveness of literacy-limited parents. Task success rate was higher for participants using the Urdu interface at all times The achieved approximately 35% more successful and completed tasks 40-50% faster than those using the English interface. Voice instructions were a key facilitator which enabled independence in executing the task. and boosting general confidence in the app's use.

The results point to the importance of addressing culture and language in parental monitoring technologies. By combining icons for easy understanding, audio and bilingual support, care, guiding and monitoring applications can help to fill literacy gaps and guarantee equal access to children's care. safety tools. Future work could involve other modes of interaction such as gesture-based or haptic feedback and could be expanded to other low-literacy populations and different cultural backgrounds.

6.Discussion

The results of the usability evaluation confirm that the multimodal child monitoring interface using a bilingual language (Urdu/English) is highly beneficial for low-literacy parents in improving their performance of the task. The high rate of task success (35%) and faster completion time (40 - 50% less) among participants using the Urdu interface supports the effectiveness of voice-guided, culturally adapted multimodal cues.

Qualitative observations show that intuitive icons, minimal text and bilingual voice guidance led to less cognitive load and the ability to complete the tasks independently including SOS. Real-time GPS tracking, social media monitoring, and emergency alerts all in one system made for a better user experience and a more efficient workflow than traditional, text-only systems. The results support an inclusive approach to HCI design and prove that multimodal, bilingual interfaces can address literacy barriers and can be replicated in any low-literacy child monitoring system.

Declaration

Author Contributions

The authors' contributions to this manuscript are detailed as follows: Sadeeq Jan was responsible for conceptualization, methodology, and drafting the original manuscript; Imran Maqsood handled data curation, formal analysis, and validation; Mujtaba Hassan contributed to investigation, resources, and visualization; Jalal Khan performed writing review and editing; Mareena Karim oversaw supervision, project administration, and funding acquisition. All authors have reviewed and approved the final manuscript and accept accountability for all aspects of the work.

Data Availability

All relevant data and supporting material used in this study are in the manuscript.

Conflict of Interest

The authors state that none of the work described in this study could have been influenced by any known competing financial interests or personal relationships.

Ethics Approval

The 1964 Helsinki Declaration and its subsequent amendments, as well as the ethical guidelines set forth by the national and institutional research committees, were followed in the conduct of this study. The Institutional Review Board (IRB) of UET Peshawar granted ethical permission for this study.

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