

Analyzing Sugar Nurse Diabetes Management Application Through the Lens of Affordance Theory

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This research delves into the integration of affordance theory within the diabetes management application Sugar Nurse in the dynamic Chinese market. Through an in-depth examination, the study unveils the distinctive affordances offered by Sugar Nurse, tailored to address a spectrum of user needs and environmental variables. Focusing solely on Sugar Nurse, the research underscores the pivotal role of functional, cognitive, behavioral, sensory, and emotional affordances in elevating user experience and fostering engagement. The findings underscore the necessity of adopting a comprehensive design approach that acknowledges the multifaceted nature of user requirements and environmental influences in crafting user-centric digital health solutions. Such insights provide valuable guidance for the future development of health management applications.

Keywords: diabetes management, interaction design, Chinese market, affordance

Introduction

Affordance theory, originating from direct perception and Gestalt psychology, highlights the intricate link between object properties and the perceiver's subjective state. James Gibson furthered this concept, defining affordances as directly perceivable potentials for behavior (Lawrence, Giles, Tsoi, & Back, 1997; Calder et al., 2001). This perspective, advanced by the second generation of cognitive science, emphasizes cognition as an embodied experience that evolves through interaction with the environment, moving beyond the earlier focus on cognition as akin to computer processing (Ahonen, Hadid, & Pietikäinen, 2004; Aleksic & Katsaggelos, 2006). Gibson's idea of environmental "giving" reflects the dynamic relationship between organisms and their surroundings, where different species perceive unique affordances based on their own physiological and social makeup (Tullis & Albert, 2008; Llinares & Aero, 2008). For example, what serves as a resting place for monkeys can be a resource for tools for humans, showcasing the diversity of interactions with the environment (Perez-Gaspar, Caballero-Morales, & Trujillo-Romero, 2016; Liu et al., 2017).

Affordance Theory: Key to UX Interaction and Design

Affordance theory serves as a foundational concept in UX interaction design (Norman, 1988). It provides a fundamental understanding of how users perceive and interact with digital interfaces, guiding designers in creating intuitive and user-friendly products (Gibson, 1979). The relevance of affordance theory to interaction design lies in its emphasis on usability, user-centric design, error prevention and correction, feedback

mechanisms, and efficiency improvement (Lee & Marshall, 2013). By incorporating affordance principles into the design process, designers can effectively address users' needs, behaviours, and expectations, ultimately enhancing the overall user experience.

Importance of Affordance Theory in UX Interaction

The importance of affordance theory for UX interaction lies in providing designers and developers with a framework to create more user-friendly and intuitive products. Initially proposed by Donald Norman, affordance is defined as the quality of the interaction between users and systems, as well as the ease with which users can accomplish tasks within the system (Lee & Marshall, 2013).

- **Usability:** Affordance theory emphasizes that designed products should be easy to learn and use. By considering users' cognitive, psychological, and behavioral characteristics, designers can create interfaces and functionalities that are more intuitive and easy to operate, thus improving the usability of the product.
- **User-centric design:** Understanding affordance helps shift design from being technology-driven to user-driven. Designers and developers need to focus on users' needs, expectations, and behaviors to ensure that their products can meet users' actual requirements and provide a satisfying user experience.
- **Feedback and visibility:** Affordance theory emphasizes timely feedback and interface visibility, allowing users to clearly understand the results of their actions, thereby increasing their sense of control and satisfaction with the system (Kaptelinin & Nardi, 2006).

This theory challenges traditional Cartesian views by advocating for an ecological understanding of perception, where the environment is seen not just as a backdrop but as a participant in behavior and cognition (Ahonen, Hadid, & Pietikäinen, 2004; Wightman, Kistler, & Arruda, 1992). It calls for a deeper exploration of ecological information and the application of affordance in design, suggesting that a nuanced appreciation of these concepts can lead to innovative ecological design and cognitive science approaches. Gibson's work invites researchers to blend an understanding of affordances with human cultural insights, marking a path toward enriching design practices (Wightman et al., 1992; Cao, Yang, & Tu, 2005).

Within the context of affordance theory in interaction design, the dynamic interplay among users, products, and the environment emerges as the foundational elements that define and drive the concept of affordance (Gibson, 1979; Norman, 1988). Affordance, fundamentally, describes the potential actions that an object provides to a user, deeply rooted in the properties of both the user and the object, as well as the contextual nuances of the environment in which these interactions occur (Lee & Marshall, 2013; Gaver, 1991). This triad—users, products, and the environment—constitutes the essential components of affordance, shaping the interaction capabilities and possibilities within a system.

1. Users embody the individuals engaging with the product, bringing their own cognitive models, physical capabilities, and emotional states into the interaction. Their perceptions, experiences, and actions are central to realizing the affordances offered by a product within an environment (Kaptelinin & Nardi, 2006).

2. Products represent the tangible or intangible objects of interaction, designed with inherent properties and functionalities aimed at fulfilling specific user needs or actions. The design of a product communicates its affordances, suggesting its use through visual, tactile, and auditory cues (Norman, 1988).

3. The environment encompasses the physical, social, and cultural context in which user-product interactions take place, influencing the perception and realization of affordances. It provides the backdrop against which the product's use is situated, affecting how its affordances are understood and employed by users (Gibson, 1979).

The concept of affordance is inherently relational and contextual, necessitating a comprehensive understanding of the interconnections between user characteristics, product features, and environmental factors (Norman, 1999). These elements collectively determine the affordances available, influencing how interactions are facilitated and perceived. The affordance of a product is not solely a property of the product itself but emerges from the interaction between the user and the product within a specific environmental context. This perspective underscores the multifaceted nature of affordance, highlighting the importance of considering the holistic user experience in design processes.

In essence, the affordance within interaction design is a synergistic outcome shaped by the confluence of user capabilities, product properties, and environmental context. It emphasizes the need for designers to deeply consider these three elements in concert to create intuitive, effective, and satisfying interactions. By acknowledging and leveraging the intricate relationships among users, products, and the environment, designers can enhance the inherent affordances of a system, thereby improving its overall utility and user experience.

Methodology

Research Framework

Functional. Functional affordance refers to the practical and utilitarian aspects of how users interact with products to achieve specific tasks or goals (Gibson, 1979). It embodies the fundamental actions that a product facilitates, such as the ability to click a button or swipe a touchscreen. The emphasis is on the tangible outcomes of interaction, highlighting the importance of designing products that clearly communicate their use and effectively support the intended functionalities.

Cognitive affordance. Cognitive affordance deals with how a product's design aligns with the user's mental models and cognitive processes (Norman, 1988). It focuses on the ease with which a user can understand how to use a product, based on the clarity of its design and the predictability of its functions. Cognitive affordance is about reducing cognitive load, making interactions intuitive, and ensuring that users can seamlessly grasp the functionality of a product without extensive instruction.

Behavioral affordance. Behavioral affordance centers on the ways in which a product guides or influences user behavior (Lee & Marshall, 2013). This dimension explores how design cues can prompt specific actions or habits, encouraging engagement and interaction. It includes considerations of how design can shape user behavior over time, fostering learning, habit formation, and potentially changing how users approach certain tasks or activities.

Emotional affordance. Emotional affordance reflects the capacity of a product to evoke or influence emotional responses (Gaver, 1991). Design elements can generate feelings of satisfaction, joy, or frustration, significantly impacting the overall user experience. Emotional affordance underscores the need for design that not only meets functional needs but also resonates on an emotional level, creating a positive and meaningful connection with the user.

Perceptual affordance. Perceptual affordance pertains to the sensory aspects of interaction, encompassing how users perceive and interpret the product's design through sight, sound, touch, and more (Kaptelinin & Nardi, 2006). It involves the immediate physical and sensory feedback users receive during interaction, such as the tactile response of a keyboard or the visual feedback from an interface. Designing for perceptual affordance means ensuring that sensory cues are clear, pleasant, and informative, enhancing the overall intuitiveness and satisfaction of the user experience.

Table 1

Classification and Application Guidelines of Affordance in Interaction Design

Affordance classification	The type of interaction	Guidance basis	Interactive guidance	Main role	Design ideas
Sensory affordance	Sensory interaction	The user's visual, auditory, tactile, and other perceptual instincts	Guided by intuitive sensory elements	Help users get information	Optimize the interface design, and use elements such as color, shape, size, and layout to enhance the perceptual efficiency and aesthetics of information
Cognitive affordance		User past memories, experiences, etc.	Leverage the user's prior experience and knowledge	Help users understand the information	Incorporate the user's background and experience, and use design elements such as symbols, metaphors, and analogies to reduce the difficulty of understanding
Behavioral affordance	Behavioral interactions	The operating logic of the user using the product	Design interactions that match user habits	Help the user perform the action	Intuitive and consistent operation logic is designed, and a variety of interactive gestures are supported to adapt to the operation habits of different users
Functional availability		User tasks	Make sure that the functionality of your app or product meets the needs of your users	Help users complete tasks	Emphasizing the comprehensiveness and compatibility of functions, clearly defining the functional hierarchy and logic, and ensuring that users can easily complete the target task
Affective affordance	Emotional interaction	User experience	Touch the user's emotions through design	Meet the deep emotional needs of users	Through visual elements, interactive effects, content presentation, etc., establish an emotional connection with users

The table reveals that affordance, as it pertains to the interaction between products and users, can be categorized into sensory, cognitive, behavioral, functional, and emotional affordances. These categories work in tandem to naturally guide users' perceptions, cognitions, and behaviors, fulfilling their functional tasks and emotional needs. This research delves into a detailed dissection of these five classifications of affordance to deepen our understanding of the interactions between products and users across sensory, cognitive, behavioral, functional, and emotional dimensions. Each category of affordance is designed around users' intuition, experience, operational logic, task requirements, and emotional experiences, ensuring that products can naturally lead users to satisfy their comprehensive needs. This holistic design methodology not only enhances the user-friendliness and efficiency of products but also significantly boosts overall user satisfaction and emotional connection.

Rationale for Case Study Selection

The rationale for analyzing these applications is their status as representative products in the field of diabetes management on the Chinese market. Each app addresses the management needs of diabetic patients from distinct perspectives and functionalities. An in-depth analysis of these applications will reveal the design features, user acceptance, and how they support users in various environments within the Chinese market. These applications cater to different target user groups—patients, doctors, and broader users with chronic diseases—showing the diversity in design philosophies for meeting comprehensive health management needs, professional medical services, and fostering user interaction.

Furthermore, the selection of these applications is based on several key considerations:

- Showcasing the status of diabetes management technology in China: Analysis of these popular applications in the Chinese market provides a comprehensive overview of the development and application of digital health management technologies in China.

- Understanding the impact of different application strategies on user behavior: These applications influence users' management behaviors through various design strategies, such as providing personalized recommendations through data analysis, improving data recording convenience via user interface optimization, and enhancing user interaction through social features.
- Exploring the implementation of affordance theory across different applications: By examining how these applications are designed across the dimensions of functional, cognitive, behavioral, emotional, and perceptual affordances, we can deepen our understanding of how affordance theory is applied in actual product design.
- Evaluating the impact of environmental factors on the efficacy of diabetes management applications: The social-cultural background and healthcare environment in China provide specific environmental factors for the design and use of diabetes management applications. Through these case studies, we can explore how these environmental factors influence application design and user experience.

Sugar Nurse App in China's Diabetes Market

Before presenting the chart illustrating the market share of the Sugar Nurse application in China's diabetes management market, it is relevant to provide some context. The diabetes management sector in China is witnessing significant growth, necessitating a thorough understanding of market dynamics and competitive positioning.

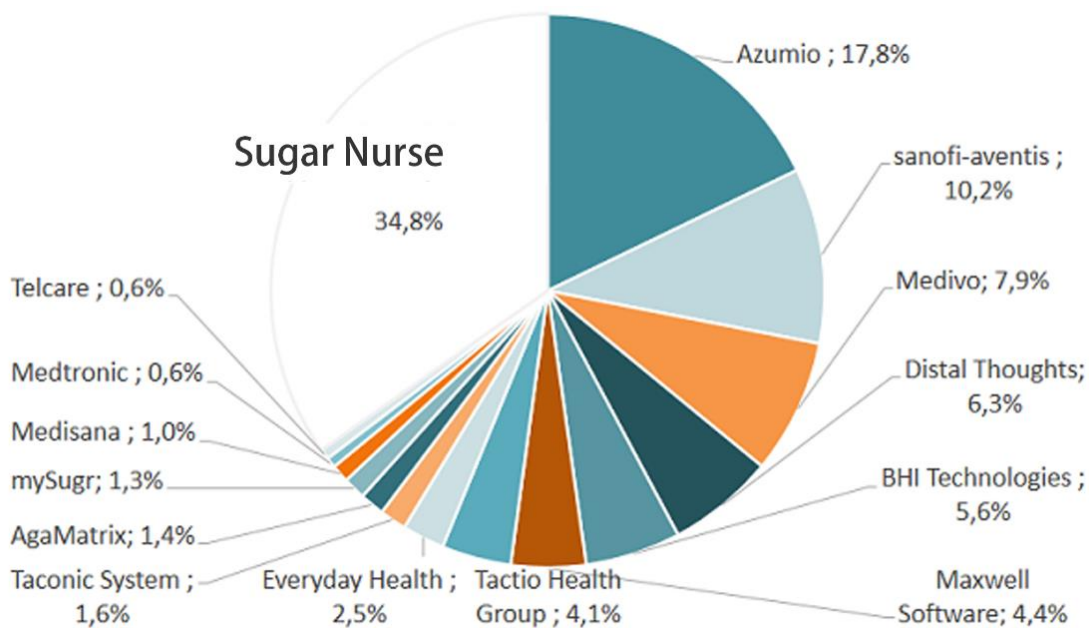


Figure 1. Sugar Nurse app in China's diabetes management sector.

In this context, the inclusion of a chart detailing the market share of the Sugar Nurse application becomes imperative. As a mobile application offering diabetes management and health monitoring services, the performance of the Sugar Nurse application within the Chinese market garners considerable attention. The forthcoming chart will outline the relative market position and share of the Sugar Nurse application compared to its competitors (Guo, 2022).

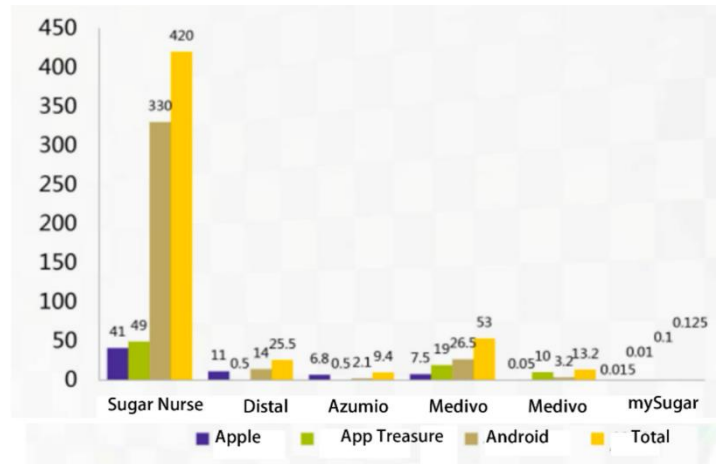


Figure 2. Statistical analysis of diabetes-related app downloads in the Chinese market (Unit: 10 Thousand).

Discussion

Having elaborated on the rationale for selecting Sugar Nurse, Datang Medical, and Xianfengniao for analysis, we now delve into how these applications meet the complex needs of diabetes management through their design. By conducting case studies on these representative products, we aim to explore their affordance characteristics and design philosophies from the crucial dimensions of users, products, and the environment.

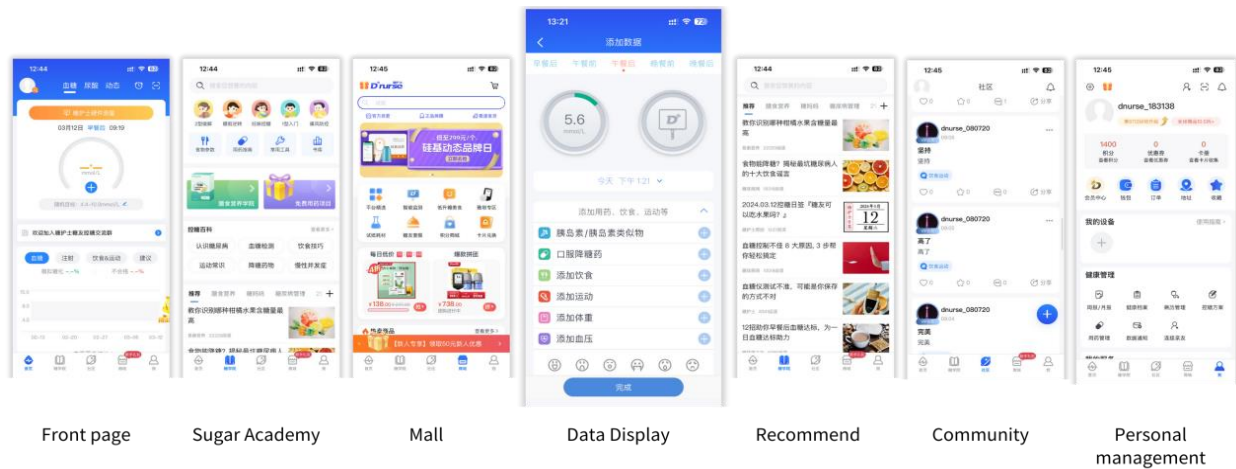


Figure 3. Sugar Nurse.

The table below summarizes the main features of these three applications, including the developer, app name, slogan, main interface display and functionalities, and the affordance elements related to user factors, product factors, and environmental factors. This will provide us with a clear framework for understanding how these applications implement affordance theory in practice.

Through a comparative analysis of diabetes management applications—Sugar Nurse by Beijing Sugar Nurse Technology Co., Ltd., each application, originating from considerations of user factors, product factors, and environmental factors, introduces a range of innovative solutions to enhance the health management experience for users. Whether through providing personalized management advice, optimizing user interface and interaction experience, or accommodating the needs of users in diverse environments, these applications demonstrate the

extensive potential of diabetes management technology to improve management efficiency, enhance user interaction, and support use across various contexts.

After our analysis focusing on the user, product, and environmental aspects of the three case studies—Sugar Nurse, Datang Medical, and Xianfengniao—it’s important to clarify the scope of our forthcoming analysis. While we have delved into these critical dimensions, the subsequent section of our paper will concentrate on a detailed examination of the Sugar Nurse application across the five dimensions of affordances: functional, cognitive, behavioral, sensory, and emotional. This focused approach allows us to illustrate the nuanced application of affordance theory within a specific context of diabetes management technology.

Table 2

Comparative Analysis of Diabetes Management Applications: User, Product, and Environmental Factors

Developer	App name	User factors	Product factors	Environmental factors
Beijing Sugar Nurse Technology Co., Ltd.	Sugar Nurse	The Sugar Nurse app is designed for diabetic patients, taking into account their needs for monitoring blood sugar and managing the disease. It provides personalized management suggestions to meet the health management needs of different users.	This application optimizes the user interface and interactive experience through smart device data collection and analysis functions, making blood glucose monitoring and daily management simple and efficient.	Considering that diabetes management needs to be carried out in a variety of environments, the Sugar Nurse app supports mobile devices, making it convenient for users to use in different physical environments. It also integrates into the user’s social and cultural environment to provide popular science knowledge and health advice.

The decision to focus on Sugar Nurse was strategic, aimed at providing a detailed case study that illustrates the application of affordance theory in digital health management. This choice allows for a focused exploration of how diverse affordance dimensions can significantly enhance user experience and engagement. As we proceed to discuss the broader implications of our findings, it’s important to consider the potential applicability of these insights to other applications like Datang Medical and Xianfengniao, encouraging future research to extend this affordance-based analysis to a wider range of health management tools.

Table 3

Functional Affordances

Functional affordance	Description
Data monitoring	The Sugar Nurse app automatically records blood sugar and other health data by connecting to devices such as blood glucose meters, allowing users to monitor their own health status in real time.
Medication and insulin management	Convenient for users to record and track medication and insulin usage to ensure safe and effective medication.
Health analysis	Utilizes the collected health data to provide users with insights into their health trends, enabling informed health decisions.
Diet recommendation	Analyzes dietary habits and suggests adjustments to improve blood sugar levels and overall health.
Device connection	Supports connection with various health monitoring devices and simplifies the data synchronization management process.
Data security	Sugar Nurse pays attention to the security of user data and takes encryption and other measures to protect user privacy and data security.
Health assistant	Offers personalized health management advice and reminders for medication, testing, and doctor appointments to assist users in managing their condition effectively.

These additions aim to encapsulate a broader spectrum of functional affordances provided by the Sugar Nurse app, illustrating how it supports users in managing diabetes through comprehensive health monitoring, insightful analysis, and tailored health recommendations.

Table 4

Cognitive Affordances

Cognitive affordance	Description
Health education	The function provides a wealth of diabetes-related knowledge and health information to improve users' self-management capabilities.
Navigation architecture	The app design is clear and easy to navigate, allowing users to quickly find the functionality they need.

This table outlines the cognitive affordances of the application, highlighting features that enhance users' understanding and ease of use. Health education efforts empower users with knowledge for better diabetes management, while thoughtful navigation architecture ensures that users can efficiently access the tools and information they need.

Table 5

Behavioral Affordances

Behavioral affordances	Description
Sports tracking	Record users' exercise data to encourage a healthy lifestyle.
Medical consultation	Provide users with direct access to healthcare professionals for personalized medical advice and consultations, enhancing the management of diabetes.
Interactive share	"Support users to share experiences within the community, learn from and encourage each other", fostering a supportive environment for mutual motivation and engagement in health management practices.

This table focuses on the behavioral affordances provided by the application, showcasing features that motivate user actions and interactions. Sports tracking functions motivate users towards healthier lifestyles by recording and analyzing their exercise data, while the interactive sharing feature fosters a supportive community where users can exchange experiences and encouragement.

Table 6

Sensory Affordances

Sensory affordances	Description
Data visualization	Visually display health data through charts and other forms to facilitate user understanding.
Healthy and simple design	"The interface is simple and beautiful, improving user experience" by minimizing clutter and focusing on essential features for ease of use.
Interactive feedback	Provide real-time responses to user inputs and actions within the app, enhancing engagement by making the interaction feel more dynamic and responsive.

By visually presenting health data in an accessible and understandable manner, the application makes it easier for users to comprehend their health status and progress. The emphasis on a healthy and simple design ensures that the user interface is not only appealing but also straightforward, minimizing cognitive load and making the app more user-friendly. Furthermore, interactive feedback mechanisms are essential for creating a dynamic user interaction experience, where users feel their inputs are immediately recognized and valued, fostering a deeper engagement with the app.

Table 7

Emotional Affordances

Emotional affordances	Description
Social media login	Support social media account login to simplify the registration and login process.
Soothing tips	Provide users with calming and motivational messages or advice, aimed at reducing stress and enhancing emotional well-being during their health management journey.

Emotional affordances such as social media login and soothing tips play a crucial role in enhancing the user's emotional connection with the application. By streamlining the login process and offering reassuring guidance, the app not only caters to the practical needs of users but also addresses their emotional well-being, creating a more supportive and engaging health management experience.

Results

Based on our comprehensive discussion and analysis of the selected diabetes management applications—Sugar Nurse, Datang Medical, and Xianfengniao—this paper has illuminated the multifaceted role of affordances in enhancing user experience within the realm of health technology. Through a meticulous examination across five key dimensions of affordance: functional, cognitive, behavioral, sensory, and emotional, we have derived insightful observations on how these applications cater to the complex needs of their users, not merely by facilitating disease management but also by fostering a supportive and engaging user environment.

The analysis reveals that the success of these applications in meeting users' health management needs lies not only in their functional capabilities but also in their design's ability to resonate with users on cognitive, behavioral, sensory, and emotional levels. Functional affordances ensure that users can perform essential health monitoring and management tasks efficiently. Cognitive affordances reduce cognitive load and enhance the usability of the application. Behavioral affordances guide and motivate users towards healthier lifestyle choices. Sensory affordances create an intuitive and engaging user interface, while emotional affordances connect with users on a deeper level, providing support and motivation.

Furthermore, the integration of social media login features and the provision of soothing tips are examples of how applications can leverage emotional affordances to enhance user engagement and satisfaction. These features not only simplify the user's interaction with the app but also contribute to a positive emotional experience by offering ease of access and emotional support.

In conclusion, this study underscores the importance of a holistic approach to application design, where understanding and addressing the wide range of user needs through the lens of affordance theory can significantly impact user engagement and satisfaction. The findings from this analysis not only contribute to the body of knowledge in interaction design and health informatics but also offer practical insights for developers and designers aiming to create more effective and user-centered health management applications. As digital health technology continues to evolve, the principles of affordance theory remain a critical tool for designing solutions that are not only functional but also deeply resonant with users' lives.

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