LogYourEatingHabits: A Dietary App Focusing on Eating Habits that Promotes Healthy Lifestyles

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Abstract: Maintaining healthy eating habits is essential for the overall health and well-being across all ages. While mobile dietary applications offer assistance, their complexity of meal logging and often poor design limit widespread adoption. This study presents the development of a mobile application, named LogYourEatingHabits, which is designed to simplify meal logging and emphasize both meal content and eating patterns. Emphasis was also placed on ensuring high usability and accessibility in the application, making it usable by as many user groups as possible. Using a user-centered design approach, the application was iteratively developed and improved throughout feedback from 16 participants over five iterations. Each iteration provided new insights, leading to enhancements such as more consistent design and interaction of user interfaces, and increased intuitiveness and user-friendliness. The System Usability Scale (SUS) scores showed improvements across iterations, and together with observation and interview findings, they indicated overall high perceived usability. Future works include expanding the food database, optimizing the image recognition feature and providing personalized feedback based on data gathered within the app.

1 INTRODUCTION

Mobile applications (apps) have emerged as a promising tool to assist individuals in monitoring daily diets. However, the complexity in meal-logging and complicated user interfaces appear to be significant barriers to the widespread adoption of these technologies (König et al., 2021). Most mobile dietary apps focus on what we eat, not when and/or how we eat. Studies have shown that the duration and pattern of eating have an impact on our health (Mattson et al., 2017). There are many positive health benefits linked to various dietary strategies, like time-restricted eating, which involves consuming all food within an 8–10-hour window instead of a 12–14-hour window. Potential benefits of such eating habits include increased energy level, improved sleep quality and reduced body weight for those who need better weight control. Many user groups, such as elderly people, busy professional, and students, face the risk of not maintaining healthy eating habits. Here, the term "habit" refers to the routine of eating, instead of what one eats.

Despite the growing use of mobile apps for tracking food intake, significant usability and accessibility challenges remain (König et al., 2021). Many existing apps often fail to provide simple and user-friendly interfaces, which can limit long-term usage. Particularly for older adults who often find these interfaces confusing or difficult to navigate (Aure et al., 2020), they are more vulnerable to poor dietary habits. For users of all ages with limited digital skills, user-unfriendly interfaces make navigation within the apps complicated , leading to reduced long-term use of these apps (Wei et al., 2020). For a mobile dietary app, usability is crucial in determining how effectively users interact within an app and a lack of easy to use design often leads to negative user experiences (Fuglerud et al., 2018). The term "easy to use" implies that end-users can understand, learn, and navigate across the interfaces with minimal effort. While most apps emphasize logging food intake and providing nutritional information, they often overlook important factors such as when and how meals are consumed (König et al., 2022). Eating habits are essential in affecting

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outcomes such as energy levels, sleep quality, and weight management (Longo & Panda, 2016).

To address these knowledge gaps, the aim of this study is to design and develop a mobile app that focuses on logging both meals (what they eat), and eating times and patterns (when and how meals are taken). This app, named LogYourEatingHabits emphasizes easy of use for a diverse audience, considering variations in age, gender, culture, and other socio-demographic factors. We acknowledge that it is impossible to provide a one-size-fits-all solution, but the intention is to make this app usable and accessible to as many user groups as possible.

2 METHODOLOGY

In this study, we adopted user-centered design (UCD) approach, which allowed us to actively involve users to ensure the design meets the needs of its target audiences (Gould & Lewis, 1985). This approach guided the design and development of the LogYourEatingHabits app, following the four key phases proposed by (Benyon, 2019): understanding, envisionment, design, and evaluation. Figure 1 shows the overview of entire research process, detailing the four phases of UCD. We describe the details of each phase in the next section.

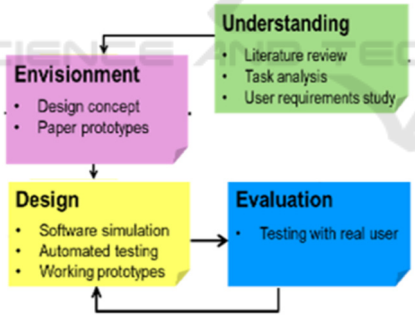

Figure 1: UCD processes used in this study.

2.1 User-Centered Design Approach

The first phase of UCD focused on understanding usability and accessibility challenges in existing dietary apps. To achieve that, we conducted a comprehensive literature review and analysis of existing dietary apps. The next phase, i.e., envisionment phase involved brainstorming and conceptualizing the design of the app, informed by the insights gained from the understanding phase. During this phase, several low-fidelity prototypes were created to explore different design options and user interface layouts. These prototypes helped visualize the app's functionality, navigation and user interaction, ensuring that the design addressed the usability and accessibility challenges identified in the understanding phase. These prototypes provided the foundation for the design and development of high-fidelity prototypes in the next phase. These early-stage designs focused on structuring the app flow and key features.

In the third, i.e., design phase, a high-fidelity prototype was created. The high-fidelity prototype included detailed user interface design elements to ensure that LogYourEatingHabits was not only easy to use and accessible, but also functional and responsive across different devices and screen sizes. This phase also includes making changes to improve on the design. Lastly, evaluation phase focused on gaining inputs for continuous improvement in design (the third phase) through user testing. This phase was essential in ensuring that the app met its usability and accessibility goals.

2.2 Recruitment, Data Collection and Analysis

User testing (evaluation phase) and process of improving the prototype (design phase) were repeated in five iterations. Using convenience sampling, participants were recruited from a diverse socio-demographic backgrounds to ensure a range of perspectives and user experiences. They were informed about the objectives of the study and briefed about their participation. Consent must be given prior to participating in the study. Before user testing, we collected demographic data, including participants' self-rated digital skills.

User testing in each iteration involved participants performing specific tasks, which included logging meals (both manually through a menu, and using images from their camera or gallery), accessing the food diary, and using the reminders. To access the food diary, participants had to navigate to it and review their logged meals to observe their eating habits over time. For the reminders, participants were first asked to set and edit reminders for meal times. When the reminder alerted them, they were then required to log their meal. These tasks were designed to reflect real-world use cases, concerning the usability and accessibility of the app. When they performed the testing tasks, we observed how they completed them. Questions were asked to clarify and gain more insights using a semi-structured interview guide after they have completed the tasks.

The System Usability Scale (SUS) questionnai-re was used to provide a quantitative assessment of the

app's usability (Brooke, 2013). After each user testing, participants were requested to complete the SUS questionnaire, which included 10 questions rated on a 5-point Likert scale. Scores for positively worded statements (odd-numbered items) were computed by subtracting one from the participant's response. For negatively worded statements (even-numbered items), we subtracted the participant's response from five. We summed these individual scores and multiplied the total by 2.5. SUS scores, along with observational and interview data from each iteration, were analysed to guide iterative improvements, enhancing ease of use and usability in each new version of the app.

3 RESULTS

3.1 Participants

Table 1 presents the demographic information of all participants, and their participation in this study. The participants represented user groups of diverse backgrounds in age, education, digital skills and experiences in using dietary app. All of them used smartphone daily. In general, we noticed that younger participants generally learned to use LogYourEatingHabits quicker, while older participants required more time to become familiar with its features. Differences in digital skills also affected their learning and user experience when they first started using our app. Participants with experience using dietary apps like MyFitnessPal and Fitbit (P1, P3, P7, P8) found the app easy to navigate around, while others with no experience with any dietary app (P2, P5) provided more feedback on making the design easier to use. Although all participants came from different socio-demographic backgrounds, they all shared a common interest in improving their eating habits.

3.2 Understanding

In this first phase of the UCD process, usability and accessibility challenges of existing diet-logging app were identified and gathered through a literature review. This review highlighted several common issues that helped shaping the design of the app, ensuring a more user- friendly and accessible app for a diverse range of users. Table 2 summarizes these issues and how we targeted to address them.

3.3 Envisionment

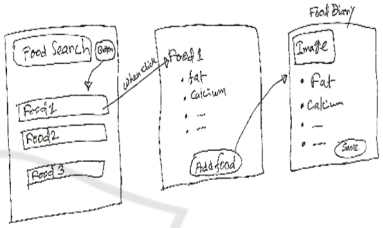

Figure 2: Low-fidelity prototype.

In this phase, several low-fidelity prototypes were developed based on the insights gained from the understanding phase. Figure 2 demonstrates some of these prototypes, showing the early-stage designs. Key features included food logging, profile settings, and diary management. Using simple paper sketches, the research team explored and discussed different layouts and designs, before landing on the final decision of the design of the first iteration.

Table 1: Participants' profile.

Tester	Age	Gender	Education level	Digital skill level	Participated in iterations	Other
P1	29	Male	Master's degree	Advanced	1,2,3,5	Familiar with dietary app MyFitnessPal.
P2	62	Male	High School	Intermediate	1,2	Unfamiliar with any dietary app.
P3	28	Female	Master's degree	Advanced	1,2	Familiar with dietary app Lifesum.
P4	37	Female	Doctorate Degree	Intermediate	2	Familiar with Lifesum, MyFitnessPal.
P5	55	Male	Bachelor's degree	Intermediate	2	Unfamiliar with any dietary app.
P6	50	Female	Vocational Degree	Novice	2	Unfamiliar with any dietary app.
P7	21	Female	High School	Intermediate	1,2	Familiar with dietary app Fitbit.
P8	42	Male	Master's degree	Intermediate	1,2	Familiar with Fitbit.
P9	49	Female	High School	Intermediate	3	Unfamiliar with any dietary app.
P10	24	Female	Bachelor's degree	Expert	3	Familiar with Fitbit.
P11	29	Female	Bachelor's degree	Expert	3	Familiar with Lifesum.
P12	32	Male	Master's degree	Advanced	4	Familiar with dietary app Lose It!
P13	24	Male	Bachelor's degree	Expert	4	Familiar with Lose It!
P14	63	Male	High School	Intermediate	4	Unfamiliar with any dietary app.
P15	19	Female	High School	Intermediate	4	Familiar with Fitbit.
P16	71	Male	Master's degree	Intermediate	5	Familiar with MyFitnessPal.

3.4 Design and Evaluation

In these two phases, high-fidelity prototypes were developed and then evaluated. These processes were iterated in five iterations. During evaluations, users performed testing tasks such as logging meals, managing diary entries, and setting reminders. Automated testing was conducted, ensuring that each design improvement and new features were thoroughly tested before user testing of each iteration. This testing allowed for early detections of possible accessible issues. The qualitative results (observation and interview) about design and evaluation of each iteration are detailed in the following sub-sections, along with figures showing the evolution of the user interface and features.

3.4.1 First Iteration

In this first iteration, key functionalities, such as manual and camera-based meal logging, accessing food diary, as well as reminders, were implemented. With the camera-based meal logging feature, users could log their meals more easily. The reminder function included an alarm and in-app notifications that prompted users to log their meals according to their preferred mealtimes. These features were crucial as the app aimed to focus on users' eating habits, not just what they have eaten. Metaphorical icons, such as a camera symbol for image-based food logging and a food symbol for choosing a pre-defined meal from a list, were used in conjunction with text labels to make user interfaces easy to understand. To provide a seamless experience across different screen sizes and orientations, we implemented a responsive design.

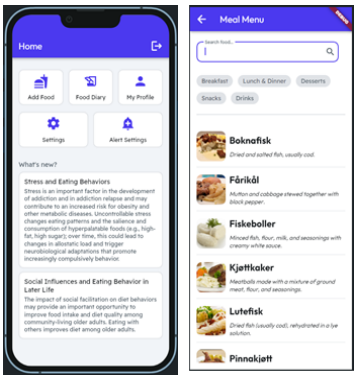

Figure 3: Screenshots of the high-fidelity prototype in the first iteration.

Figure 3 illustrates the prototype in this iteration, with the home page on the left and the meal menu page, where users can choose a meal to log, on the right. During the user testing, the participants identified two main issues. First was the inconsistent scrolling function on the food diary page. Second was the need for a larger search bar in the food diary.

3.4.2 Second Iteration

Improvements were made to the scrolling function on the food diary page to ensure its consistent operation. The width of the search bar was increased as well. A new feature implemented in this iteration was to add a home button at all pages, so that navigation could be enhanced to ensure smoother transitions between interfaces. Figure 4 illustrates the updated interface with improved navigation and usability based on user feedback from the first iteration.

Table 2: Identified usability and accessibility issues through literature review and proposed approaches to address them.

Identified issues	Approaches to address identified issues
Lack of user involvement during design and development process causing poor user experiences (Almoraie et al., 2024).	Adopts a UCD approach in this study to ensure the app meets users' needs.
Many apps had complex user interfaces, hindering user understanding and navigation (Aure et al., 2020).	Designs simple, easy-to-use user interfaces to simplify navigation and reduce complexity.
Inconsistent menu layouts hindered navigation (Choi et al., 2021).	Implements consistent menu layouts with navigation paths, and features like a home button for easy access.
When it comes to data presentation, users were confused by too much information at once (König et al., 2021).	Considers users' cognitive abilities when organizing data presentation.
Many apps did not meet accessibility standards (Fuglerud et al., 2018).	Follows WCAG 2.0 guidelines, and ensures clear contrast, descriptive labels, and accessible UI elements.
Real-time nutritional feedback was lacking in many apps (Wei et al., 2020).	Integrates real-time nutritional information, allowing users to instantly see the nutritional value of their meals.
Users found manual logging time-consuming and user-unfriendly (Simpson et al., 2017).	Implements image-based logging, allowing users to upload pictures from mobile phone camera or gallery to log meals.

Testers noticed that there were a few pages missing the home button, and that include the search food diary page (refer to Figure 4 on the right) and the meal menu page (Figure 5 on the left).

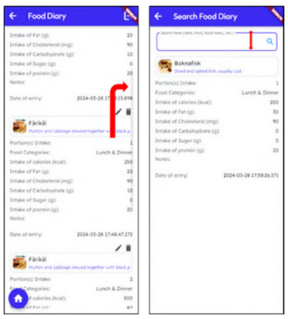

Figure 4: Improvements made, i.e., a functioning scroll bar and increased width for the search bar.

3.4.3 Third Iteration

In this iteration, we ensured all pages had a home button; One of them was the meal menu page, as shown in Figure 5. During user testing, participants suggested adding confirmation messages for successful meal logging and sorting the food diary by date, with the most recent entries appearing first.

Figure 5: Adding home button to the meal menu page.

3.4.4 Fourth Iteration

Figure 6: Snackbar notifications to confirm successful logging of food entries.

Building on previous feedback, this iteration added two new features i.e., snackbar notifications for successful meal logging (Figure 6) and sorting the food diary by date. We also implemented the support for multilingual to make the app accessible and usable for non-English speakers. Testers in this iteration appreciated the ease of use of the app. To make the app even better, they suggested including date-based search features in the food diary.

3.4.5 Fifth Iteration

In addition to testing all functionalities, we placed extra focus on assessing the enhanced search functionality. These enhanced features allowed users to search by date and food item directly within the food diary, as illustrated in Figure 7. In the user testing this iteration, P16 suggested to add a search icon next to the text “To search your diary, click here” on the food diary page, making it easier for users to understand how to use the feature. This suggestion was incorporated in the last version of prototype, as shown in Figure 8. He also suggested that a summary feature to provide users with an overview of their eating habits over a specified period, highlighting eating patterns, caloric intake, and nutritional balance. In addition, P1 noticed an inconsistency in the design of a button. On the notification preferences page, an add icon was placed instead of a home button.

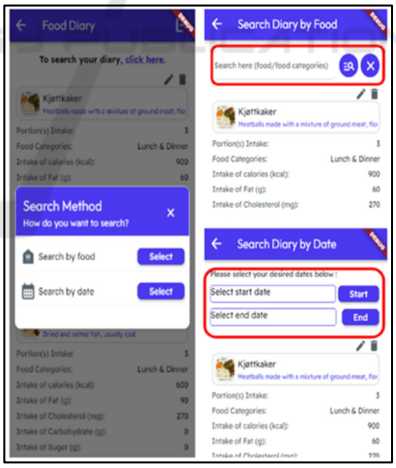

Figure 7: Improvements made to the search functionality.

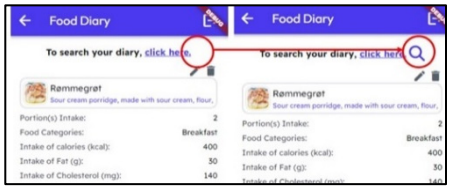

Figure 8: Search icon added on the food diary page.

3.5 System Usability Scale (SUS)

The SUS scores ranged from 65 to 90 during iterations, indicating acceptable to high levels of perceived usability. Participants who engaged in multiple iterations consistently reported improved SUS scores in later iterations, reflecting the positive impact of the ongoing improvements and modifications made to LogYourEatingHabits. Table 3 summarizes the SUS results of all participants.

4 DISCUSSION

4.1 Usability and Accessibility Issues

Previous research has consistently highlighted the importance of usability as an essential factor for the success of mobile health apps, particularly for older adults and users with lower technical proficiency (Aure et al., 2020; Fuglerud et al., 2018). These issues were related to navigation, food logging functionalities, interface clarity, and so on. Our aim of the study has always been making the user interface as simple as possible. This has resulted in testers in our study perceived the app as easy to use and all of them were satisfied in using it for the first time. Similar to the findings by Fuglerud et al. (2018), our findings confirm that improving the clarity of the interface significantly enhances perceived usability and then user satisfaction.

We implemented a key accessibility feature, i.e., multilingual support, which is an important yet often missing feature in many mobile health-related apps. Research has shown that language barriers can prevent non-English-speaking users from effectively using health apps (Hughson et al., 2018). By integrating multilingual support in the third iteration, we ensured that LogYourEatingHabits was inclusive for non-English-speaking users. Some usability issues pointed out by the participants in this study were align with design guidelines and principles. This clearly indicates that we could have had conducted a heuristic evaluation before proceeding with user testing. The observation of icon placement inconsistencies in both second and fifth iteration indicates the importance of maintaining interface consistency, a usability heuristic proposed by Nielsen (1994).

4.2 Contribution to Research and Practice

This study contributes to the existing research about mobile dietary apps by focusing on the feature of eating habits rather than solely on meals, and by addressing usability and accessibility issues found in current mobile dietary apps on the market. With the use of reminder and food diary features, LogYourEatingHabits focuses on logging eating habits, an aspect that has been relatively neglected in many dietary apps. By looking at both nutrition intake of each meal, and eating patterns (how often and when meals are taken) can offer new possibilities for further research. To the best of our knowledge, the only app that has the same focus is myCircadianClock. However, according to Gioia et al. (2023), this app scored poorly in terms of usability. Gioia et al. (2023) identified and evaluated 11 mobile dietary apps that incorporated a time stamp logging feature from the US app stores. Most of these apps were not recommended to be used in research and clinical settings due to functionalities and data privacy. The only app that was deemed good enough, Bitesnap, is not available in Norway. Therefore, we hope that once LogYourEatingHabits is fully developed, with both all functionalities and ensuring data privacy, it can be utilized for research and clinical use in Norway.

4.3 Limitations

First, the small sample size and use of convenience sampling limited participant diversity, especially among older adults, which may affect the generalizability of the findings. Our intention was to make the app beneficial to a vulnerable user group among older adults, i.e., those who have health issues due to eating habits and/or a lack of interest in mobile dietary apps. However, this user group was less available for participation. Automated testing was helpful, but browser-specific limitations underscore the need for more comprehensive expert evaluations to identify accessibility challenges overlooked by automated tools.

Another limitation was the incomplete implementation of image recognition feature. While it was an innovative part of LogYourEatingHabits, it needed a large number of images to accurately identify meals. The image recognition algorithm that we had implemented was limited to identifying only 60 meals that we had trained in a dataset. The app was unable to accurately identify random or untrained food items outside of this dataset. Enhancing the image recognition algorithm and expanding the image database would improve the accuracy and ease of use of this feature in the future.

Table 3: The system usability scale (SUS) results for all user testing.

Participants	P1				P2		P3		P4	P5	P6	P7		P8		P9	P10	P11	P12	P13	P14	P15	P16
Iteration	1	2	3	5	1	2	1	2	2	2	2	1	2	1	2	3	3	3	4	4	4	4	5
I think that I would like to use this system frequently.	4	4	4	4	3	3	4	5	4	3	5	3	4	2	5	4	2	3	3	1	4	3	3
I found this application to be unnecessarily complex	2	2	2	1	2	1	2	2	2	2	2	2	1	1	1	2	1	2	1	1	2	2	2
I thought this application was easy to use	4	4	4	5	4	5	4	4	4	4	5	4	5	4	4	4	4	5	4	5	4	4	4
I think that I would need the help of a support person to use this application	2	1	1	1	2	1	2	2	2	1	1	2	1	1	2	2	1	1	2	1	1	1	1
I found the various functions in this app were well integrated	3	4	5	4	4	5	4	3	4	4	4	4	4	4	3	4	4	4	4	5	5	4	4
I thought there was too much inconsistency	2	3	2	1	3	4	2	2	2	2	1	2	2	1	1	3	1	1	2	1	2	2	2
I would imagine that most people would learn to use this application very quickly	3	4	4	5	3	4	3	3	3	4	4	4	4	5	5	4	5	4	4	5	5	4	4
I found this application very cumbersome to use	2	2	2	1	2	1	2	2	2	2	1	2	1	1	1	2	1	1	2	1	2	2	2
I felt very confident using this application	4	4	4	4	3	5	4	4	4	4	4	4	4	3	4	4	3	5	4	5	4	4	3
I needed to learn a lot of things before I could get going with this application	2	2	1	2	2	1	5	2	2	2	2	2	1	2	1	2	2	4	2	1	1	1	2
SUS Score	70	75	82.5	90	65	85	65	72.5	72.5	75	87.5	72.5	87.5	80	87.5	72.5	80	80	75	90	85	77.5	72.5

5 CONCLUSIONS

In this study, we designed and developed LogYourEatingHabits to assist users in improving their eating habits. When developing the app, we placed a strong focus on ensuring that the app was easy to use and accessible to as many user groups as possible. However, some usability and accessibility aspects might only be assessible through long-term use. Thus, the future work shall focus on further development of the app and addressing these usability and accessibility issues.

Finally, the app should be capable of collecting comprehensive data and performing analysis on users' eating habits. The outcomes from this data analysis, which includes meal, meal timing, frequency, and portion size, can then be utilized to provide more personalized feedback. Such analysis would allow users to track patterns over time, offering insights into how their eating behaviours impact their health. When all these are in place, LogYourEatingHabits can be used and evaluated in a longer period of time with diverse user groups for its engagement, user experience and clinical effects.

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