

Design and Implementation of A Mobile-Based Refrigerator Reminder App

Rina Yulius¹, Diyah Karmila Sari²

{rinayulius@polibatam.ac.id¹, diyahkarmilasari@gmail.com² }

Politeknik Negeri Batam, Jl. A. Yani Teluk Tering Kota Batam^{1,2}

Abstract. Food waste is a serious problem in Indonesia due to a growth in population numbers. Private households have been identified as key actors in food waste generation. This study aims to develop a mobile app named 'Freeze Reminder' as a tool used for preventing the decay of food ingredients that have forgotten to be processed because they are in storage. The application is developed using The Prototyping Model of Software Development Life Cycle (SDLC). The quantitative data through a survey were conducted to examine the acceptance of The Freeze Reminder using UEQ. The results of the study verify that The Freeze Reminder app is transforming the access and delivery of food waste reducing.

Keywords: food waste, Freeze Reminder, mobile app.

1 Introduction

Waste is the remaining material from a domestic (household) production process or an industrial production process. Waste management is currently one of the priorities in many countries, including Indonesia [1]. Indonesia has been in the second position after Saudi Arabia as the country that produces the most food waste because it was found that the average Indonesian person throws away about 300 kilograms of food every year as explained by The Economist Intelligence Unit [2].

Food waste has an impact on various sectors, especially the economy [3] and the environment [4]. So now the United Nations organization has stated that it has a goal to reduce food waste by 2030 to come. Food waste currently poses a significant challenge to food security. The process of storing food ingredients is one of the main concerns to reduce food waste. Food storage has the aim of preventing spoilage in food ingredients so that the food consumed by the body is safe and produces good benefits.

Based on a preliminary study conducted in the period 14-30 October 2021 on 183 respondents spread across the Riau Islands, data showed that 77.60% of 183 respondents experienced problems in food waste management and 96% of 183 respondents stated that they needed a system that could help manage food consumption. Nowadays, people store food in chillers, refrigerators, and freezers. However, the stored material does not last long and it is often found that the food is damaged because it has been stored for too long or is damaged due to forgetting

to process it. Based on this condition, there is a need for people who want to use technology that will assist in recording the food ingredients in the refrigerator.

The purpose of the study is to create an application that can make it easier for users to record food ingredients in the refrigerator and evaluate the application's usability. The app was developed as an intervention to eliminate food waste. The application made has features that can help users get information related to the quality of food storage in the refrigerator. To clarify the research focus, the system built is limited to applications that are made only to provide reminders in the form of text, the application is only intended for household-scale refrigerator owners, the food ingredients data used refers to [5], and the application is implemented on the android operating system.

2 Literature Review

Some previous studies proposing mobile apps as a media to reduce food waste have recently been conducted. Several studies [6]–[11] focused on using food sharing schemes to reduce food waste. In [7] a mobile food sharing app was used to reduce food waste. The findings of the study have significant implications for policymakers aiming to encourage, measure, and understand technology-assisted food sharing practices while [8] building a mobile food sharing app between students and restaurants based on Persuasive Systems Design (PSD). The result of the study indicated that all of the features based on PSD were rated positively by its users. Furthermore [11] tried to eliminate food waste by intervening the retail industry by offering surplus food from retailers at a discounted price to the public through a mobile app.

Moreover some others focused on people's behavior on food consumption [12]–[14]. In [12] an AR-based mobile digital prototype was developed to mediate consumers' interaction with on-pack information attributes in their food consumption activity systems. Meanwhile [13] developed a mobile gamified app for raising awareness of sustainable food consumption, MySusCof App. Furthermore, [14] enhance user engagement within a food waste reduction purposed app that touches upon a complex topic, to ensure a good learning environment for the user.

3 Methodology

3.1 Development Model

The application design of Freeze Reminder was developed through several stages of the development life cycle using prototype model namely requirements, quick design, build the prototype, user evaluation, refining prototype, and implementation. These stages can be seen in Figure 1.

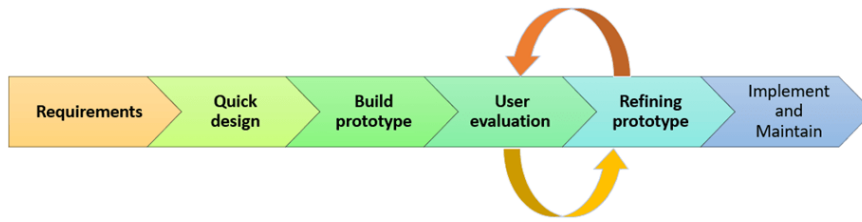


Fig. 1. Prototyping Model.

3.2 Research Model and Analysis

A quantitative approach was used in this study. 183 participants who were involved in the previous preliminary study were asked in the evaluation process through convenience sampling. Their opinion about the food waste app that has been developed was gathered through an online survey. The evaluation process used the User Experience Questionnaire (UEQ) as the research instrument. UEQ allows prompt assessment of the user experience of a product. The questionnaire scale is created to address the impression of a comprehensive user experience. The UEQ accommodates 6 test scales with a total of 26 items: attractiveness, clarity, efficiency, accuracy, stimulation, and novelty. Figure 2 describes the instruments used in the UEQ.

How do you feel about Freeze Reminder app?

	1	2	3	4	5	6	7	
annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow
inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	conventional
obstructive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	supportive
good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	bad
complicated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy
unlikable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasing
usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	leading edge
unpleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasant
secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	not secure
motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	demotivating
meets expectations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	does not meet expectations
inefficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	efficient
clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	confusing
impractical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	practical
organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	cluttered
attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive
friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unfriendly
conservative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	innovative

Fig. 2. UEQ instruments.

4 Results and Discussion

4.1 Mobile App Implementation

After going through the development process, we released the app to limited users to evaluate the usability of The Freeze Reminder. Figure 3 shows the interface of the Freeze Reminder app.



Fig. 3. The Freeze Reminder app

4.2 Data Analysis

Of the 183 total participants in the previous preliminary study, 142 completed the survey questionnaire and only 138 responses were complete. Thus, the remaining sample of 138 participants was considered for this study and used in the analysis. The participants' answer items of each test scale in UEQ were then analyzed. It shows the overall answers from a total of 138 participants with a total of 26 answers each. The answer value shows a rating scale of 1 to 7. Then, we transform the answer item into the weight of the answer value. In order, the following are pairs of scales and their weights: (1,-3), (2, -2), (3, -1), (4,0), (5, 1), (6, 2), (7, 3). Furthermore, we calculate the value of means, variance, and standard deviation of each data. In the standard interpretation values between -0.8 and 0.8 represent a neutral evaluation of the corresponding dimension, values more than 0.8 represent a positive evaluation, and values less than -0.8 represent a negative evaluation. The range of the scales is between +3 (positive extreme) and -3 (negative extreme).

Figure 4 shows the scores for all scores of UEQ. Findings from the UEQ showed that the scores for all scales describing a pragmatic quality aspect (Efficiency, Perspicuity, Dependability) are good, i.e., above 0.800. The scales describing hedonic quality (Stimulation and Novelty), i.e., the fun of use also show good evaluations.

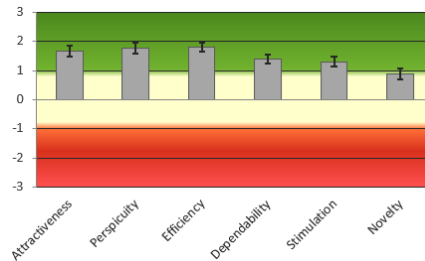


Fig. 4. UEQ Test Scale Graphic

Each average value of the UEQ calculation results is compared with the benchmark value to determine the meaning of each value. The results of the UEQ scale measurement compared to the benchmark value can be seen in Figure 5.

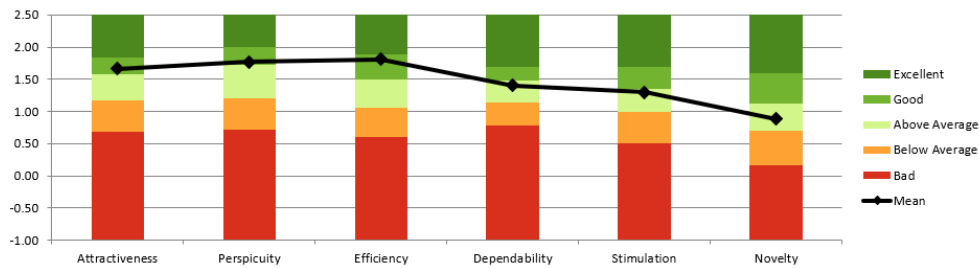


Fig. 5. UEQ Benchmark

Based on the comparison with the benchmark scale, the stimulation, dependability, and novelty aspects are above average. Meanwhile, attractiveness, perspicuity, and efficiency are good. These results indicate that The Freeze Reminder application is good but still needs to be improved by providing functions or features that help users pleasantly complete their tasks.

5 Conclusion

This study found that The Freeze Reminder app provides users with clear information to classify food ingredients according to their level of freshness so that they can set a proper time and way to cook those ingredients. It was aimed to be an intervention to eliminate food waste. The results of the study verify that The Freeze Reminder app is transforming the access and delivery of food waste reducing. Further studies need to explore the other factors of food waste-reducing activities and improve the user experience by providing better features or functions.

References

- [1] M. Nizar, E. Munir, Irvan, and V. Waller, "The integrating of zero waste principles from national to local regulations: Case study of Banda Aceh, Indonesia," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 216, no. 1, 2018, doi: 10.1088/1755-1315/216/1/012043.
- [2] The Economist Intelligence Unit, "Global Food Security Index: Country profile," 2017. [Online]. Available: <http://foodsecurityindex.eiu.com/Country>.
- [3] S. Ojha, S. Bußler, and O. K. Schlüter, "Food waste valorisation and circular economy concepts in insect production and processing," *Waste Manag.*, vol. 118, pp. 600–609, 2020, doi: 10.1016/j.wasman.2020.09.010.
- [4] N. D.O *et al.*, "Effects of Household Waste Generation, Disposal and Management on Farmers' Health in Owerri Metropolis of IMO State, Nigeria," *Int. J. Environ. Agric. Biotechnol.*, vol. 3, no. 5, pp. 1845–1853, 2018, doi: 10.22161/ijeab/3.5.37.
- [5] "The Food Keeper - A Consumer Guide to Food Quality & Safe Handling," Washington DC, 2002. [Online]. Available: <https://lee.ces.ncsu.edu/wp-content/uploads/2012/12/TheFoodKeeper.pdf? fwd=no>.
- [6] H. Hajjiab, A. Anzer, Hadeel A. Tabaza, and W. Ahmed, "A Food Wastage Reduction Mobile Application," 2018.
- [7] J. Harvey, A. Smith, J. Goulding, and I. Branco Illodo, "Food sharing, redistribution, and waste reduction via mobile applications: A social network analysis," *Ind. Mark. Manag.*, vol. 88, pp. 437–448, 2020, doi: 10.1016/j.indmarman.2019.02.019.
- [8] M. Häkkä, "Designing A Persuasive Mobile Application for Sharing Food Between Students and Restaurants," Sweden, 2019. [Online]. Available: <http://www.diva-portal.org/smash/get/diva2:1305650/FULLTEXT01.pdf>.
- [9] J. A. R. Morilla, Fhillip Carl Bagsic, Mark Kenneth Dela Cruz, Carl Daniel A. Patio, and Emeliza R. Yabut, "Foodernity: A Mobile and Web Application for Food Sharing," 2021, doi: 10.1109/iCORE54267.2021.00035.
- [10] A. Andres and J. C. Sandhi, "Sharing Food with FoodLifeSavr Smartphone App," in *2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS)*, 2022, no. April, doi: 10.1109/ICAIS53314.2022.9743040.
- [11] W. T. Wong, Owen Noel Newton Fernando, Chitra Panchapakesan, and Jessica Kee Si Jia, "Foodcover: Eliminating food waste in the retail sector through technology," 2021, doi: 10.1109/CW52790.2021.00020.
- [12] W. Chu, R. Wever, K. Verghese, and H. Williams, "Thinking on the Box : Design On-pack Information Attributes to Influence Consumers ' Food Waste Behavior," 2019.
- [13] R. Haas, H. Aşan, O. Doğan, C. R. Michalek, Ö. Karaca Akkan, and Z. A. Bulut, "Designing and Implementing the MySusCof App—A Mobile App to Support Food Waste Reduction," *Foods*, vol. 11, no. 15, p. 2222, 2022, doi: 10.3390/foods11152222.
- [14] A. D. Titiu and A. D. Titiu, "Designing a gamified application to promote food waste awareness in household and further educate consumers on their food waste behavior," University of Twente, 2019.