Food Container with Expiration Date Reminder (OPTIMA) as the Solution to Minimize Leftover Food

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Abstract. As time goes by, food waste has become one of the global issues that needs to be addressed due to its adverse impact on the economy, environment, and social. Preliminary study shows 77% of respondents leaves the food until it expires. Moreover, a study shows that most of the reason consumers discard the food is to avoid the food which almost and has expired. OPTIMA is a food container with expiration reminder product design which aims to avoid expired food disposal. This innovation can be integrated with mobile phone application so that consumers can control the expiration period of stored food in order to be optimized before the expiration date. The expiration date will be displayed on the LED display and indicator lights using the battery power source. It was designed with PDCA process (Plan, Do, Check, Action). Based on usability test through the prototype, 60% of respondents only had less than or equal to one error to use the product for the first time, 80% of respondents stated that the product can be used easily, 80% of respondents were satisfied with the product. It is expected to be used as one of the medias of actualization and development of technology to find alternative and innovative solutions to the problem of food waste stacking and expected as the innovation for household technology.

Keywords: Food waste, expiration date, food container

1. Introduction
Food waste is a significant problem in the food supply chain [1]. Over time, food waste is one of the global issues that needs to be addressed because it has a negative impact on the economic, environmental and social aspects. In developed countries, household is one of the largest sources of food disposal [2]. A study shows that 31% of food is wasted; with a percentage of 21% by consumers and 10% by food producers. Figure 1 below shows the percentage of food waste produced by consumers.
Since most of food wastes come from households, studies are conducted to observe the consumer behavior. The results show that the reason consumers discard their food is to avoid the expiration date and lack of food storage management skills which becomes concerning [2]. Food containers made from plastic become one of important things of household lately. The function of plastic as a food and beverage container gets the biggest attention due to its versatile function [3]. In this recent decade, customers are willing to have products which have more value added [4]. The value added can be in form of either non-wasteful process, multifunctional, or technology presence.

This paper presents the product innovation of food container with expiration date reminder which can be integrated with applications on mobile phones so that consumers can control the food expiration period that is stored and can be optimized before the expiration period.

2. Methods

Kaizen philosophy was used in designing the product, which includes the stage of plan, do, check, and action (PDCA). A quality management applied in these stages will define the structural problem solving in response to continuous customer feedback [5]. It has been extensively used in many aspects; business process, manufacturing, and product development. There are four stage in PDCA. Plan is the first stage, which is about to define purpose, goals, and objectives based on data collection earlier [6]. At plan phase, 75 questionnaires were distributed to housewives, students, employees and teaching staffs to perceive the voice of customers which then translates into customer needs, so that the attributes that need to be in the product design will be known.

Do is the second stage which is to identify needs, change, and implementation. In this research, Do stage is to make the prototype of the product used in the manufacture of prototypes include iron plate, RTC, LED lights, and the application based on the output of the questionnaire for the size and product material needed by consumers.

Check is the third stage which is used for monitor, evaluate, and analyze the change which compares previous and new data [6]. One of the methods to evaluate product is usability testing. Usability is a related but complementary, concept that defines the quality of the interaction between people and systems. If ergonomics and human-centered design are the means to create products that fit people, usability is how we measure the fit [7]. Usability is a critical dimension of product quality that affects product success [8]. It is defined in terms of efficiency, effectiveness, user satisfaction, and whether specific goals can be achieved in a specified context of use [9]. Usability testing is done by asking the respondents to operate the prototype directly with certain tasks. The task is started with turn
the product on, put the food container in the particular place, input the data needed to the OPTIMA application in the phone, read the information from the LCD screen, end with interview to obtain the specified target.

Act is the last stage of PDCA. It is to adjust strategies for improvement and refine the product. Based on the stages of planning, prototyping, and evaluation, the inspection and further research are done to improve the tools to reduce errors and failures in the product so the product can be operated according to its function. Then, the granting of Patent Rights is carried out in an effort to maintain authenticity and avoid acts of plagiarism.

3. Results and Discussion

3.1. Questionnaire Results

The questionnaire involved 75 respondents in which 56% of respondents were housewives. The results of the questionnaire are shown in the table below:

| No. | Question                        | Answer         | Percentage (%) |
|-----|---------------------------------|----------------|----------------|
| 1   | Intensity of Leaving Food        | Ever           | 77             |
|     | Through the Expiry Period       | Never          | 23             |
|     |                                 | Dry Food       | 37             |
|     |                                 | Cake, cookies  | 30             |
| 2   | Type of Food Stored             | Fresh Food     | 25             |
|     |                                 | Cooked Ingredients | 5   |
|     |                                 | Herbs          | 3              |
|     |                                 | Plastics       | 60             |
| 3   | Desired Food Container Material | Glass          | 27             |
|     |                                 | Acrylic        | 13             |

The results of the questionnaire can then be summarized to make the following voice of customers:

1. As many as 58 of the 75 respondents or 77% of respondents stated that they had left food until they passed the expiration period.
2. The type of food most frequently stored by respondents in a food container is dry food, which is as much as 37% of respondents.
3. The food container material needed by respondents is made from plastic as much as 60% of the respondents.

3.2. Product Design

Based on the results of the voice of the customer, a food container design is made as shown below:
The specifications of OPTIMA are:
1. Handle on the side of the products; serve to facilitate the transfer of products.
2. Medium-sized container, as food containers that can replace as desired.
3. LCD screen to indicate the time and type of food.
4. Indicator light, which lights up according to the expiration date. Green light means there are 3 days or more left before the expiration date, yellow light means less than 3 days before the expiration date, red light means the expiration date already exceeded.
5. The power button on the back of the product.
6. Integrated with applications on smartphones using the Bluetooth feature shown in figure 3.

### Figure 3. Application Interface

#### 3.3. Work Mechanism

The working mechanism of the OPTIMA product is explained in the scheme below:

![OPTIMA Work Mechanism](image)
This product uses 2 dry batteries as its resources. As it has been filled with a dry battery, the product can be turned on by clicking on the power button on the back of the product. Then the user enters the data in the form of expiration date and type of food on the OPTIMA application that has been integrated in the smartphone. After inputting, the countdown time will run and the indicator light will light up according to the expiration date. The existence of these features is expected to be able to minimize food expiration by paying attention to the indicator lights on the product.

3.4. Usability Testing Result
Usability testing is done by giving the task to respondents in using OPTIMA products. The task given is starting from when turning on the product to reading the information on the LCD screen. The attributes examined were Learnability, Satisfaction and Effectiveness with the following results:

| No | Learnability | Satisfaction | Effectiveness |
|----|---------------|--------------|--------------|
| 1  | 5             | 5            | 2            |
| 2  | 4             | 5            | 0            |
| 3  | 4             | 4            | 2            |
| 4  | 4             | 5            | 1            |
| 5  | 4             | 5            | 1            |

Based on Table 2, it was found that as many as 60% of respondents claims that this product is effective to use with an error rate of less than 1 time, 80% of respondents stated that the product could be used easily, and 80% of respondents stated that respondents were satisfied with OPTIMA products.

4. Conclusion
OPTIMA is a product design in the form of metal plate containing 3 pieces of food container that can be replaced as needed which designed by PDCA aspects. There are 3 LCD screens to display the food name and expiration date that has been inputted through the application on the smartphone with the help of the Bluetooth feature. OPTIMA testing has been carried out with usability testing which resulted that this product is usable to be used.

However, the improvement of this product is needed along with the development of technology. Thus, the suggestions given for the further research is to maximize information technology so that the application connected with the product can be better by adding pop up reminder features on smartphones and improving the interface to be more user-friendly. Ergonomics aspect also should be considered by improve the handle, product material, and brightness level of the indicator light.

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