Design of a Food Sharing App Using Kansei Engineering and Fuzzy Linguistic Methods

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Abstract

COVID19 has a negative impact on Indonesia's economic stability, so people must help each other and share, particularly in the food sector. Despite having a high level of hunger, Indonesia ranks 12th in the world in terms of food waste production. In order to overcome this phenomenon, a user-friendly food sharing application is required. Hence, Kansei Engineering is used in this study to design an application to capture the user's emotional needs, as well as a fuzzy approach to explain the user's feature needs. Furthermore, the prototype was tested for performance and usability using the System Usability Scale (SUS) questionnaire to determine the most usable design. As results, an application with a "cool concept" is a recommended design with higher efficiency and satisfaction values.

Keywords

Food sharing, Application, Kansei Engineering, Fuzzy Linguistic, System Usability Scale

1. Introduction

One of the most serious consequences of the COVID19 pandemic is the impact on economic stability, such as not being able to purchase enough food, resulting in hunger, not being able to pay for essential expenses such as rent or utilities, reduced income, and so on (Alzueta et al. 2021). As a result, it is critical to assist and share in order to reduce its impact, particularly in the case of hunger and food waste. However, there have only been a few product developments aimed at reducing Indonesia's high rate of hunger and food waste. According to Yanti (2021), 1.03 billion tons of food are wasted each year. This means that 17% of food produced is wasted. Furthermore, Indonesia ranks 12th in the world in terms of food waste (Tiseo 2021). According to data from the BAPPENAS (National Research Agency) published in the Jakarta Globe (2021), Indonesia wastes an estimated 115-184 kg of food per year. This is sufficient to meet the nutritional needs of 61-125 million people each year. On the other hand, Indonesia, the world's fourth-largest country with over 250 million people, continues to suffer from hunger. According to data from the Asian Development Bank (ADB) and the International Food Research Institute (IFPRI) in (La 2020), 22 million Indonesians were undernourished. In fact, according to the Global Hunger Index Team (2020) assessment, Indonesia is at a moderate hunger level, ranking 70th in 2020. These phenomena must be overcome in order to achieve sustainable development in accordance with the United Nations Development Program's (2015) goals of zero hunger (number 2) and responsible consumption and production (number 12).Creating a food-sharing app that incorporates the user's emotional interests is one solution to this problem. User emotions and feelings can influence user experience in ways such as loyalty (Huff 2015; Nagamachi & Lokman 2011), attracting attention, bringing users happiness and satisfaction, and being more focused on customer desires (Nagamachi 1995). The Kansei Engineering method can be used for this approach.

This approach has been used in application design research to develop food packaging (Suzianti & Aldianto 2020), educational applications and e-learning (Hadiana 2017; Mud'Is et al. 2019; Naim & Ibrahim 2014; Nugroho et al. 2019), e-commerce applications (Hadiana 2016; Lokman & Noor 2006), various service concepts (Hsiao et al. 2017; Yeh & Chen 2018), knives (Razza & Paschoarelli 2015), and underwear (Pan et al. 2015). In other studies, the Kansei Engineering approach is combined with other methods to provide a more detailed explanation of user requirements, such as integration with the KANO model (Ginting & Hadiana 2018; Llinares & Page 2011), QFD model (Hartono et al. 2013), and Fuzzy linguistics (Chanyachatchawan et al. 2017; Kwong et al. 2016; H. Soewardi & Maulidyawati 2018; Hartomo Soewardi & Nasution 2016).

According to these last ten years researches, the Kansei Engineering approach has never been used to develop food sharing application interface designs, and research on application interfaces has never been integrated with the fuzzy approach. As a result, the purpose of this research is to create a food sharing application interface using the Kansei Engineering approach to obtain user emotions toward the proposed design, which is then completed by Fuzzy Linguistics to clarify the user's feature needs as a form of support for the creation of sustainable development

1.1 Objectives

The purpose of this study was to identify kansei words and to specify a food sharing application based on the kansei engineering method and its features based on fuzzy linguistics. It also provides usability test results to recommend the most user-friendly design for food app sharing.

2. Literature Review

Kansei engineering is a technology that combines kansei (emotions and feelings) with engineering disciplines. By analyzing human emotions and incorporating them into product design, this method applies product development that refers to human happiness and satisfaction processed using technology (Nagamachi & Lokman 2011). Kansei engineering, according to Schütte (2005), is a concept and methodology that is strong in the concept of development as well as a framework in which tools and methods are continuously developed, added, and integrated. Kansei Engineering considers size, design method, and experimental validation in its application.The features will be explained by fuzzy logic which is a tool for capturing fuzzy information, which is typically described in natural language, and converting it to a numerical format (Li et al. 2017). Moreover, final prototype is assessed by usability test by System Usability Scale (SUS). The SUS is a simple scale of ten question items that provides a global perspective for subjectively evaluating usability (Brooke 2020; Nielsen 1993).

3. Methods

The kansei engineering method's processing begins with collecting kansei words that involved 195 respondents, validating kansei words, collecting comparison products, distributing semantic differential questionnaires to 195 respondents, conducting statistical tests, determining and conducting principal component analysis, and performing partial least squares. After obtaining the design elements based on Kansei engineering processing, further explanations on some aspects of user needs are provided using fuzzy linguistics that involves 6 UI/UX designer experts. This stage begins with the definition of fuzzy variables, followed by the creation of categories, the formulation of rules, and the execution of the fuzzification process. Then, after completing the final element design, prototyping, validation, and usability tests were carried out in the final stage of the research. The testing will be based on performance metrics and a system usability scale questionnaire.

4. Results and Discussion

4.1 Result of Kansei Words

The first step in determining the kansei word is to distribute a questionnaire that asks respondents what they expect from the user interface design of a food sharing application. The results are then compared to the kansei term used by Nagamachi & Lokman (2011). After obtaining 12 kansei words, semantic differences were made to determine whether the kansei words were required in designing a food sharing application, where 1 means strongly disagree and 5 means strongly agree that the word is used to design the application. Finally, the results of this assessment were statistically tested in order to produce the 12 kansei words required by respondents with sufficient, valid, and reliable data, as shown in table 1. The minimum data for the Slovin adequacy test is 132 respondents, but the study uses 195 respondents so that the data is declared sufficient. The data validity test discovered that r table was 0.141 and that all test values (r count) were greater than r table, indicating that the data was valid. Finally, the reliability test revealed that r table was 0.141 and that all test values (r count) were greater than r table, allowing the data to be declared valid.

Table 1. Kansei Words

Negative Words	1	2	3	4	5	Positive Words
ugly						Beautiful
Not Calm						Calm
Unclear						Clear
Not fun						Fun
Retro						Futuristic
Unimpressive						Impressive
Heavy						Light
Untidy						Neat
Debilitating						Refreshing
Complicated						Simple
Unsophisticated						Sophisticated
General						Unique

4.2 Product Benchmarking

These 12 Kansei words will be tested using a benchmarking product and a differential semantic questionnaire in the form of a Likert scale, with the lowest value representing a negative Kansei word and the highest value representing a positive Kansei word. This study's benchmarking product criteria include similar products, such as sharing applications, having more than 10,000 downloads, and having different application color themes. Then there are five comparison apps to choose from: ResQ Club, Surplus, Ywaste, Karma, and Treatsure. Differential semantic questionnaires were distributed to 195 respondents in order to calculate the average value for each kansei for the five comparison benchmarking products shown in table 2. According to the slovin adequacy test, 195 were declared sufficient, as well as validity tests (r table: 0.576) and reliability tests (r table: 0.576), indicating that the data is valid and reliable.

Table 2. Average Kansei Value

	ResQ	Surplus	Ywaste	Karma	Treatsure
Beautiful	4.78	4.78	3.02	3.78	3.12
Calm	3.77	4.98	3.33	2.29	2.26
Clear	4.31	3.73	2.67	3.27	3.47
Fun	4.44	3.65	4.15	2.18	3.45
Futuristic	4.65	2.88	2.44	3.12	2.65
Impressive	4.30	3.01	2.01	2.78	2.72
Light	4.87	4.51	3.29	2.07	3.83
Neat	4.67	3.97	3.39	3.50	3.76
Refreshing	4.50	4.12	4.02	3.15	3.51
Simple	4.95	4.02	3.95	3.21	3.42
Sophisticated	3.49	4.53	3.59	2.10	3.33
Unique	4.04	4.04	3.41	3.38	3.41

4.3 Principal Component Analysis

The main objective of using a dimension reduction feature like Principal component analysis is to identify the most significant words that have the greatest impact on the user's emotions while using the application. Factor analysis is a statistical method for examining the relationship between variables (Hair et al. 2009). This factor analysis procedure was carried out with the help of IBM SPSS Statistics v.20, a statistical application. Principal Component Analysis (PCA) is the extraction method for factor analysis, which is suitable for variable reduction and concludes with varimax rotation for more precise scores (Hadiana 2016). The image below Fig.1 depicts the results of the total variance in the principal component analysis process. As shown in table 3, this extraction method generates three components from twelve Kansei words to guide the creation of the application's user interface design.

Table 3. Result of Principal Component Analysis

Admirable Concept	Fresh Concept	Cool Concept
Impressive	Fun	Calm
Futuristic	Light	Sophisticated
Clear	Refreshing	Unique
Neat	Simple	
beautiful		

4.4 Design Element and Partial Least Square (PLS)

Google Material Design, the design of the comparison products mentioned above, and several journals are used to guide the design elements of the mobile application user interface (Naim & Ibrahim 2014; Nugroho et al. 2019). The table below shows the results of the design element categories that were also consulted by design experts. Then, PLS is used by researchers to determine which design elements correspond to the kansei word chosen by the respondent. The final interface design with design elements for each design concept is obtained based on the partial least square results, as shown in the table 4.

Table 4. Result of Design Concept

Sub-Category	Factor 1: "Admirable Concept"		Factor 2: "Fresh Concept"		Factor 3: "Cool Concept"	
	Avg.	0.186	Avg.	0.125	Avg.	0.093
	Range	Element	*Range*	Element	*Range*	Element
Top App Bar Color	0.308	Bright Green #18CBA8	0.222	Dark Teal #009788	0.153	Bright Green #18CBA8
Top App Bar Logo	0.174	NS	0.115	NS	0.086	NS
Top App Bar Greetings	0.151	NS	0.100	NS	0.075	NS
Top App Bar Banner	0.008	NS	0.006	NS	0.004	NS
Body Background Color	0.139	NS	0.092	NS	0.069	NS
Body Font Style	0.159	NS	0.105	NS	0.079	NS
Body Font Main Colour	0.298	Themed colour	0.197	Themed colour	0.148	Themed colour
Bottom App Bar Navigation	0.174	NS	0.115	NS	0.086	NS
Menu Navigation - Peta	0.139	NS	0.092	NS	0.069	NS
Menu Navigation - Icon Style	0.223	Popular Style	0.148	Popular Style	0.111	Popular Style
Loading Page Type	0.196	With text	0.130	With text	0.097	With text
Main Page - Type	0.308	Map	0.204	Map	0.156	Category
Settings - Bahasa	0.145	NS	0.096	NS	0.072	NS

4.5 Fuzzy Approach

The fuzzy attributes are determined using the priority rules on the Pareto chart, where the vital features are explained further using fuzzy. According to the Pareto principle, 80% of the benefits result from 20% of what is done. Alternatively, 80% of problems can be traced back to 20% of their causes (Tanabe 2018). Pareto analysis identifies problem areas or tasks that have the highest potential for yield. It means that the features that would be explained by fuzzy logic are communication system, reward system, payment system, complete food description, and pick-up system. A focus group discussion with six experts was held to determine the detailed design considerations for these five features. The number of experts involved is in accordance with Carson et al. (2011), who stipulate that the minimum number of experts in focus group discussions is six. The output in fuzzy process is same for all features which is the feasibility level as shown on table 5.

Table 5. Result of Fuzzy Approach

Output			
Term	**Description**		**Interval**
Not Feasible	Feature could not be added		[1 3 5]
Kind of feasible	Feature might be added		[3 5 7]
Feasible	Feature Could be added		[5 7 9]
Optimum Output			
Features	**Variable**	**Value**	**Description**
Communication system	Basic Ability	3	Advance (Chat and auto messages)
	Multimedia	8.5	Medium (Picture and location)
Reward system	Type of reward	6	Score
	Frequency of usage	3	Low (Reward given for every transaction made by user)
	Reward level	6	Low (Reward cannot be use for payment
Payment system	Payment method	9	Medium (Direct, transfer, and digital payment)
	Billing option	7	Basic (Personal)
Complete food description	Information	8	Advance (Picture, expired date, price, and review)
	Minimum image used	5	Medium (Min. 3)
Pick-up system	Pick-up method	6.3	Advance (Self pick-up and online transportation)
	Protection option	7	Medium (Available as an option)

4.6 Prototyping

Prototyping is done based on the results of design elements that were processed in the previous stage with partial least squares. The features are then adjusted to the reference results of the previous stage's fuzzification process. "Gifood," which stands for "give food," is the logo used. This aims to raise user awareness of the importance of not only sharing food but also of sharing love for the earth, the environment, and others. The image of a curved spoon and fork indicates that this application is related to food and supports the Sustainable Development Movement (Figure 1).

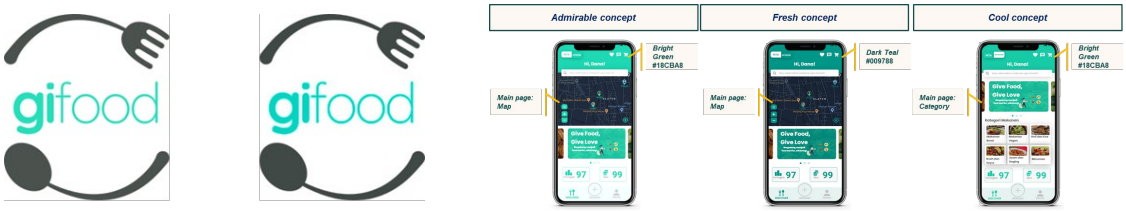

Figure 1. Logo and proposed application design

The color palette used in the application prototype is based on the theme colors determined by Kansei engineering (Bright Green #18CBA8 and Dark Teal #009788). Then, typography employs poppins, a font that is frequently used in mobile application interfaces and provides a lively, clean, and fun feel to mobile applications (Dwinawan 2019; Efe 2020). Finally, the popular style available in Icons4Design can be used to determine the icon used in the application. Based on the foregoing explanations, a food sharing application was created, which was then divided into three prototype design concepts, namely admirable, fresh, and cool, as depicted in the image above.

4.7 Testing

The final stage of developing a food sharing application is testing the prototype on users. Three application concepts were tested with four scenarios, namely as food distributors (distributing food and contacting food customers) and food recipients (ordering food and reviewing food). At this stage, the assessment indicators are carried out based on effectiveness, efficiency, error (Nielsen 1993), and satisfaction using SUS questionnaire (Bangor et al. 2009). During this phase of testing, the researcher included 5 respondents from each generation (generation X, Millennials, and Y). This is in accordance with Nielsen (Nielsen 2000), which state that usability testing requires a minimum of three respondents for each category.

It was discovered that all respondents were able to complete and successfully carry out all scenarios with a percentage of 100 percent at the level of application effectiveness assessed by the level of success and completion of users doing four scenarios. As a result, in this case, it demonstrates that all application design concepts can effectively meet the needs and desires of users.

It can be seen in Figure 2 that the product with the cool concept has the quickest completion time on average. Then came a new idea, an admirable idea, and finally the longest completion of similar products. By displaying "categories" as the main page display, this efficiency is influenced by the feeling of familiarity or user habits with application design. According to Jakob's law, users prefer products to function the same way as all other products they are familiar with, and most food-related applications in Indonesia display "categories" as the main page (Mirkowicz & Grodner 2018).

Figure 2. Efficiency test resuly

Because the user was unfamiliar with this new application, Generation Z only made one error in the error indicator when using the fresh concept design in the second scenario (contacting the food order). Meanwhile, the millennial generation only made one error when implementing the admirable concept design in the second scenario (contacting the food order) because users were unfamiliar with this new application as well. Because generation X's spatial ability (Wagner et al. 2014) to execute assignments is lower than that of other generations, mistakes are made once for each proposed design (admirable, fresh, and cool concepts) when carrying out the first scenario (sharing food) and second scenario (contacting food customers) (Figure 3).

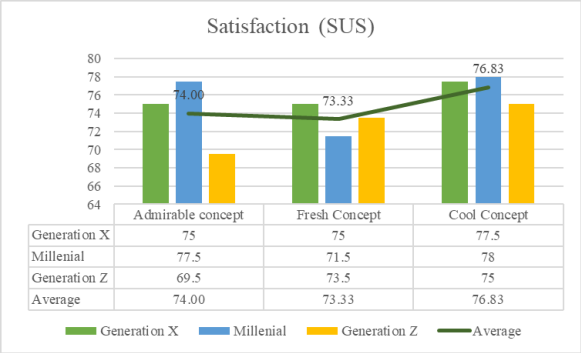

Figure 3. Satisfaction test result

All generations, including Generations X, Millennials, and Y, believe that the proposed design with admirable, fresh, and cool concepts has an adjective rating of "Good," indicating that it is suitable for use. Then, with the exception of the admirable concept by generation Z, all proposed designs are at the level of acceptance of "acceptable". This is because generation Z believes that displaying "categories" on the main page, as offered in the cool concept, will make learning process easier by user.

5. Conclusion

In conclusion, the food sharing app is built on 12 kansei words: beautiful, calm, clear, fun, futuristic, impressive, light, neat, refreshing, simple, sophisticated, and unique. The application design also includes five main features based on a fuzzy approach, namely an integrated communication system, a reward system, an integrated payment system, a complete food description, and a varied pick-up system. Based on the results of the prototype testing, an application with a "cool concept" is recommended because it has a higher efficiency and a better user experience.

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