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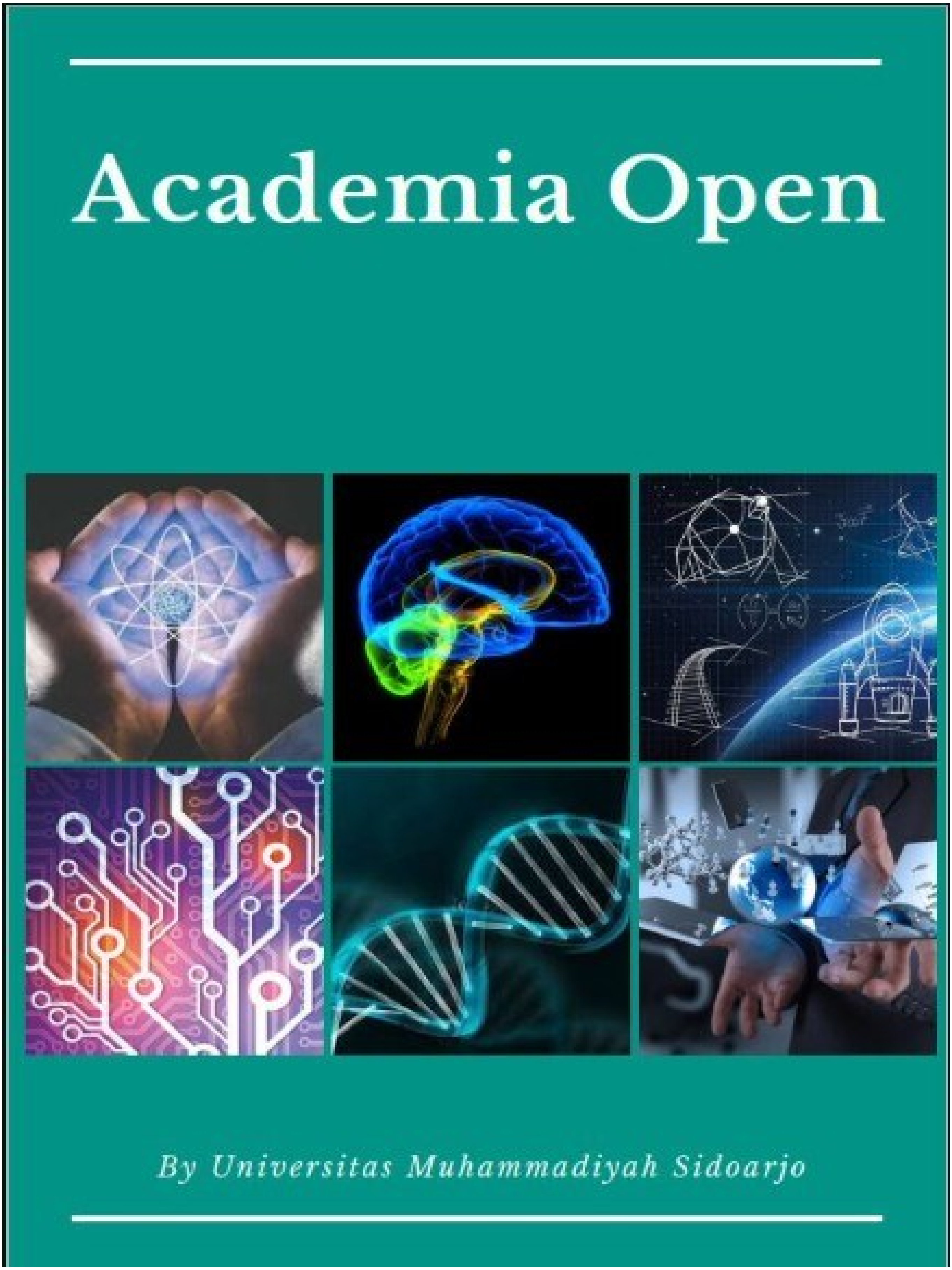

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Product Development of a Rollator Walker for the Elderly Based on Kansei Engineering to Explore Users Emotional Preferences in Supporting Independence and Improving Quality of Life

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Abstract

General Background The Indonesian population is undergoing a demographic shift toward an aging structure, leading to increased health risks and mobility limitations among the elderly. **Specific Background** Falls among the elderly frequently result in injuries that compromise independence, self-confidence, and overall quality of life, necessitating effective mobility aids such as rollator walkers. **Knowledge Gap** Current academic literature in Indonesia predominantly focuses on wheelchair development, with a notable absence of research on rollator walkers that integrate functional requirements with the specific emotional preferences of elderly users. **Aims** This study seeks to develop a rollator walker product design that addresses the functional and emotional needs of elderly residents at the Hargo Dedali Nursing Home. **Results** Utilizing Kansei Engineering and conjoint analysis, the research identified 13 critical Kansei Words—such as sturdy, lightweight, and comfortable—which were translated into design specifications. The optimized design features an iron frame, pneumatic wheels, and a firm seat base. The Marginal Homogeneity Stuart-Maxwell test confirmed no significantdifference between the developed design and theelderlyresidents' emotional requirements. **Novelty** This study employs a specialized mapping between subjective Kansei emotional preferences and objective technical design attributes to create a mobility aid that minimizes fall risks while maintaining user practicality. **Implications** These findings demonstrate the effectiveness of Kansei Engineering in mobility aid development, providing a structured framework for designing functional products that support independence and improve the psychological well-being of the elderly population.

Highlights:

- Emotional preferences for mobility aids were categorized into agility, comfort, and affirmation factors.
- Integration of Kansei Engineering successfully translates subjective user sentiments into objective physical design attributes.
- Statistical validation confirms the developed design aligns with the mobility and independence requirements of elderly users.

Keywords: Developed Product, Elderly, Emotional Preferences, Kansei Engineering, Rollator Walker

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Introduction

According to a report by the Badan Pusat Statistik (BPS) in 2024, the growth in the number of elderly people in Indonesia continues to increase in line with the increase in life expectancy. The percentage of elderly people in Indonesia reached 12% in 2024, an increase of almost 4% compared to 2015. Life expectancy also showed an increase, from 70,78 years in 2015 to 72,39 years in 2024, which means that every person born in 2024 is expected to live to the age of 72. Meanwhile, East Java ranks second highest after DI Yogyakarta, with an elderly population percentage of 16,02%, indicating that the province of East Java is entering a phase of an aging population structure. This condition emphasizes the need for special attention to the risk of falls among the elderly in East Java, given the high elderly population and the significant impact of falls on the independence and quality of life of the elderly [1].

As they age, older adults experience various changes that can occur in internal factors, such as genetics, hormones, metabolism, the immune system, cell systems, and organ systems. In addition to being influenced by internal factors, changes in older adults are also influenced by various external factors, such as social changes, psychological changes, lifestyle, and stressors [2]. This condition poses various challenges, one of which is an increased risk of health disorders and limited mobility in the elderly.

One of the main injuries experienced by many elderly people is falling. Falls among the elderly have the potential to reduce their independence in carrying out daily activities. This can also trigger a decline in self-confidence and make the elderly more cautious in their movements, thereby affecting their overall quality of life. Various efforts have been made to reduce the risk of falls among the elderly, one of which is the use of mobility aids, such as canes, wheelchairs, and rollator walkers. Wheelchairs do offer high stability, but their use tends to limit the independence of the elderly. Previous studies have shown that prolonged use of wheelchairs can cause immobilization, which can lead to pressure ulcers, joint pain, and muscle atrophy [3]. In contrast, rollator walkers better support the independence of older adults in mobility. Other previous studies have shown that the use of rollator walkers has been proven to improve postural stability in older adults with muscle weakness or balance disorders [4]. Compared to canes, rollator walkers are superior because they provide additional stability through wheels and a braking system.

On the other hand, academic studies on the development of rollator walkers in Indonesia are still limited, with research on mobility aids focusing more on wheelchairs, while studies on rollator walkers are almost non-existent, especially those exploring the emotional preferences of users. There has not been much research that seeks to develop rollator walkers that remain practical to use while also providing a sense of security for their users. From the aspect of a product that is compact and practical but still safe, there is still a gap in research to create a rollator walker product design that is able to minimize the risk of falling without reducing user practicality through the exploration of emotional preferences.

Previous research on mobility aids for the elderly using the Kansei Engineering approach has identified several Kansei Words used to explore users' emotional preferences. In the previous study, 11 relevant Kansei Words were used to explore the emotional preferences of wheelchair users, namely Dignity, Trustworthiness, Independence, Affirmation, Stylish, Stability, Safety, Comfort, Agility, Communicative, dan Futuristic [5]. Other previous studies have 9 Kansei Words were used, namely Technological, Comfortable, Safe, Sturdy, Concise, Round, Modern, Affordable, dan Lightweight to explore the emotional preferences of wheelchair users [6]. When related to the development of rollator walkers as mobility aids for the elderly, the Kansei Words to be used in this study can be derived from previous studies. Therefore, 13 Kansei Words were obtained that can be used, including Sturdy, Lightweight, Stability, Agility, Trustworthiness, Safe, Comfortable, Dignity, Independence, Concise, Modern, Stylish, dan Affirmation.

In the context of product development, Kansei Engineering is a relevant product design approach that balances product functionality with the emotional experience of its users. This method is capable of translating users' emotional needs and preferences into product design attributes [7]. In addition, this method has been proven effective in translating users' emotional needs into product design, as evidenced by previous study, which shows that Kansei Engineering is capable of producing functional products that also meet emotional needs. This study uses the Kansei Engineering Type I: Category Classification approach, which links users' subjective preferences for products with design characteristics that can be measured objectively [8]. This approach enables the development of a rollator walker that not only fulfills functional aspects but also addresses the emotional needs of the elderly.

Based on this description, this research is important to develop rollator walker products for the elderly using the Kansei Engineering approach, resulting in designs that meet the functional and emotional needs of users. This research focuses on the elderly at the Hargo Dedali Nursing Home, a branch of Surabaya Nursing Home, to explore the emotional preferences of the elderly, which are used as a reference for the development of rollator walker products. At the Hargo Dedali Nursing Home, all elderly residents aged 58–88 years old experience a decline in mobility. They can be classified into pre-elderly (58–64 years old), young elderly (65–80 years old), and advanced elderly (81–88 years old). Table 1. shows that most of the elderly at the Hargo Dedali Nursing Home had experienced falls, totaling 12 people (54,5%). Meanwhile, 10 people (45,5%) had never experienced a fall. This condition is exacerbated by diseases such as gout, diabetes mellitus, cholesterol, hypertension, and osteoarthritis, which limit the ability of the elderly to move. As a result, many elderly people need mobility aids to support their daily activities. Even though there are elderly people who do not have the diseases mentioned above, their mobility still declines with age, as shown in their unstable gait. The gait of elderly people is influenced by several parameters, such as stride width, stride length, and walking speed. These three parameters generally decline by 10-20% in elderly people as they age, which can increase the risk of falling [9].

Table 1. Distribution of Respondents at Hargo Dedali Nursing Home

Variable	Subvariable	N (%)
Fall History	Have Fallen	12 (54,5%)
	Never Fallen	10 (45,5%)

Method

A. Research Approach

This study is a qualitative study because it focuses on exploring the emotional preferences of the elderly toward rollator walker products. A qualitative approach was chosen because emotional needs cannot be fully measured numerically, but rather need to be understood by exploring the emotional preferences of older adults, which are used as a reference for developing rollator walker products. Although statistical analysis (validity test, reliability test, factor analysis, conjoint analysis) was used in the process to process the questionnaire data, the final result was still an understanding of the emotional preferences of the elderly.

B. Variable Identification and Definition

In this study, there are two main variables that are important factors and are directly related to the issues being studied.

1. Dependent Variable

Dependent variables are variables that are affected by independent variables. In this study, the dependent variables include the rollator walker product design concept, which is the final result of product development.

2. Independent Variable

Independent variables are variables that affect dependent variables. In this study, the independent variables include Kansei Words, which can affect the final result of the rollator walker product development focused on the elderly.

C. Data Collection Sources

The research data collected will be used to support the data processing process through the application of Kansei Engineering.

1. Primary Data

Primary data is information obtained firsthand, collected directly from the source. In this study, primary data was obtained through interviews with the management of the Hargo Dedali Nursing Home to obtain profiles of the elderly, including gender, age, disease history, and fall history. Other primary data was obtained through the distribution of questionnaires to the elderly.

2. Secondary Data

Secondary data is information obtained indirectly through an intermediary. Secondary data in this study was obtained from reports by the Badan Pusat Statistik (BPS) supporting data on the percentage and life expectancy of elderly people in 2015–2024; Kansei Words from literature studies; rollator walker product samples; and literature related to Kansei Engineering as a theoretical basis.

Result and Discussion

A. Product Planning

The first stage of product development is product planning, which determines the domain or scope of research [10]. The domain or scope determined in this study is rollator walkers.

B. Concept Development

The second stage of product development is concept development, where target market needs are identified, alternative product concepts are created and analyzed, and one or more concepts are selected for further development and testing [10].

C. Data Collection

The data collected in this study was obtained from primary and secondary data sources. A profile diagram of the elderly consisting of gender, age, medical history, and history of falls, as shown in Figure 1.

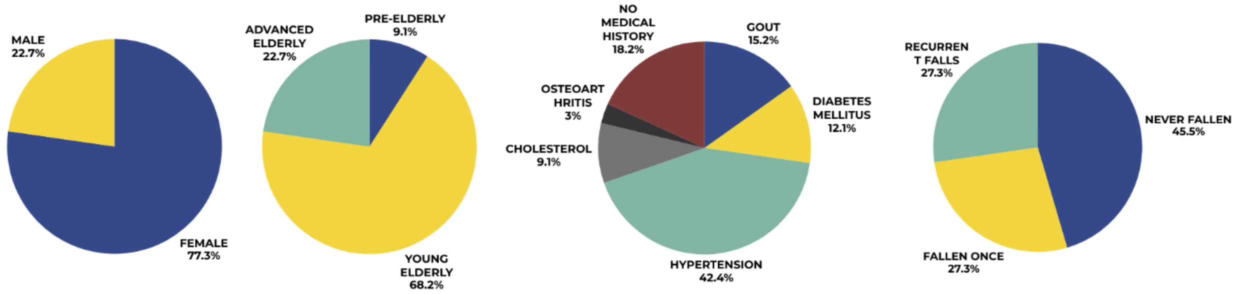

Figure 1. Percentage Diagram of the Elderly Profile of the Hargo Dedali Nursing Home

Each disease history experienced by the elderly at the Hargo Dedali Nursing Home has an effect on mobility, as shown in Table 2.

Table 2. Impact of Disease History on Elderly Mobility

No	Disease History	Disease Definition	Cause of Disease	Impact on Elderly Mobility
1	Gout	Diseases with disorders of purine metabolism that increase uric acid levels in the blood [11].	It can occur due to an unhealthy lifestyle, such as a high purine diet habit [11].	The elderly will experience complaints of severe pain and limited physical activity, thus having an impact on a decrease in quality of life [11].
2	Diabetes Mellitus	Metabolic diseases characterized by an increase in blood sugar due to insulin hormone disorders [12].	It can occur due to lack of physical activity and an unhealthy diet [13].	The elderly will experience organ health problems, especially in the deteriorating cardiovascular system, so that the ability of the elderly to do activities can decrease [13].
3	Hypertension	Diseases characterized by an increase in blood pressure above normal [14].	It can occur due to a decrease in arterial elasticity so that blood pressure increases [14].	The elderly will experience a decrease in perfusion to brain tissue, thus having an impact on balance levels and consciousness [14].
4	Cholesterol	Disease with excessive cholesterol levels in the form of wax-like fats produced by the liver and needed by the body [15] [16].	It can occur due to a lack of physical activity that can increase cholesterol levels in the blood [16].	The elderly will experience fatigue quickly, as well as experience pain and aches in the legs and neck, so that the ability of the elderly to do activities can decrease [16].
5	Osteoarthritis	Chronic joint disease characterized by inflammation and gradual damage to joint tissue [17].	It can occur due to several factors, such as obesity, joint injuries, and age [17].	The elderly will experience pain, muscle strength disorders, and decreased mobility flexibility, so that the elderly's ability to do activities can decrease [17].

Before collecting product samples to be assessed by respondents based on 13 Kansei Words, the elements and sub-elements of the rollator walker product were identified with reference to existing products. Based on these elements and sub-elements, several combinations were made using the orthogonal array method in conjoint analysis, as shown in Table 13. The results of these combinations were then visualized into 12 product samples to be assessed by respondents based on 13 Kansei Words. The results of the first questionnaire, which consisted of the assessment of 12 product samples based on the 13 Kansei Words, underwent validity testing, reliability testing, factor analysis, and conjoint analysis.

D. Validity Test

Validity testing is used to determine the accuracy and precision of an instrument in performing its measurement function [18]. The number of respondents in this study was 22 with a significance level (α) of 5%, resulting in an r_{table} using a r product moment table references of 0,423. The results of the validity test in Table 3. indicate that all items have an $r_{count} > r_{table}$, so the questionnaire results can be considered valid.

Table 3. Validity Test Results

No	Kansei Words	R-count	R-table	Remarks
1	Sturdy	0,649	0,423	Valid
2	Lightweight	0,656	0,423	Valid
3	Stability	0,754	0,423	Valid
4	Agility	0,664	0,423	Valid
5	Trustworthiness	0,516	0,423	Valid
6	Safe	0,743	0,423	Valid
7	Comfortable	0,804	0,423	Valid
8	Dignity	0,475	0,423	Valid
9	Independence	0,452	0,423	Valid
10	Concise	0,621	0,423	Valid
11	Modern	0,516	0,423	Valid
12	Stylish	0,440	0,423	Valid
13	Affirmation	0,511	0,423	Valid

E. Reliability Test

Reliability testing is used to determine the extent to which an instrument can be trusted [19]. The results of the reliability test in Table 4. indicate that the Cronbach's Alpha value obtained was 0,829 with N of items equal to 13. Therefore, the questionnaire results can be said to be reliable because the Cronbach's Alpha value obtained was greater than 0,6.

Table 4. Reliability Test Results

Reliability Statistics	
Cronbach's Alpha	**N of Items**
0,829	13

F. System-Level Design

The third stage of product development is system-level design, which involves defining the product architecture and dividing the product into subsystems and components [10].

1. Factor Analysis

Factor analysis is a stage in research that aims to convert the correlations between Kansei Words related to product design into more meaningful factors [20].

a. Barlett's Test

Bartlett's test is used to determine whether Kansei Words related to product design are sufficiently correlated to be analyzed using factor analysis [20]. The results of the Barlett's test in Table 5. indicate that the significance value is less than 0,05; so Kansei Words are sufficiently correlated to be analyzed in factor analysis by grouping them into more meaningful factors.

Table 5. Barlett's Test Results

Bartlett's Test		
Bartlett's Test of Sphericity	Approx. Chi-Square	202,387
	df	78
	Sig.	<,001

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b. Kaiser-Meyer-Olkin (KMO) Test

KMO test is used to measure data adequacy in factor analysis [20]. The results of the KMO in Table 6. indicate that the KMO value is 0,671, so Kansei Words is sufficient for further analysis because the KMO value is greater than 0,5.

Table 6. Kaiser-Meyer-Olkin (KMO) Test Results

Kaiser-Meyer-Olkin Test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0,671

c. Measure of Sampling Adequacy (MSA)

MSA is used to determine the extent to which Kansei Words in product design can be accurately predicted by other variables with minimal error [20]. The results of the MSA in Table 7. indicate that Kansei Words are worthy of further analysis because the MSA values of all Kansei Words are greater than 0,5.

Table 7. Measure of Sampling Adequacy (MSA) Results

No	Kansei Words	MSA Value	Remarks
1	Sturdy	0,640	Eligible
2	Lightweight	0,656	Eligible
3	Stability	0,855	Eligible
4	Agility	0,676	Eligible
5	Trustworthiness	0,580	Eligible
6	Safe	0,664	Eligible
7	Comfortable	0,665	Eligible
8	Dignity	0,661	Eligible
9	Independence	0,583	Eligible
10	Concise	0,736	Eligible
11	Modern	0,694	Eligible
12	Stylish	0,639	Eligible
13	Affirmation	0,684	Eligible

d. Factoring Process

The factoring process uses the Principal Component Analysis (PCA) method, which serves to simplify the data by converting correlated Kansei Words into a smaller set of independent variables [20]. Based on the percentage of each Kansei Word in the new factors in Table 8., it can be seen the percentage of variance of each Kansei Word that can be explained by the formed factors. For example, the Kansei Word Sturdy has an extraction value of 0,7999; which means that 79,99% of the Kansei Word variance can be explained by the formed factor. The highest extraction value is in the Kansei Word Comfortable at 90,8%, and the lowest extraction value is in the Kansei Word Concise at 0,413. In addition to the extraction value, there is an initial value for each Kansei Word of 1,000, which means that all Kansei Word variance has a percentage of 100% before extraction.

Table 8. Communalities Results

Communalities				
No	**Kansei Words**	**Initial**	**Extraction**	**Variance Explained by the Factors (%)**
1	Sturdy	1,000	0,799	79,9%
2	Lightweight	1,000	0,609	60,9%
3	Stability	1,000	0,846	84,6%
4	Agility	1,000	0,792	79,2%
5	Trustworthiness	1,000	0,721	72,1%
6	Safe	1,000	0,843	84,3%
7	Comfortable	1,000	0,908	90,8%
8	Dignity	1,000	0,691	69,1%
9	Independence	1,000	0,844	84,4%
10	Concise	1,000	0,413	41,3%
11	Modern	1,000	0,542	54,2%
12	Stylish	1,000	0,756	75,6%
13	Affirmation	1,000	0,858	85,8%

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The results of the total variance explained in Table 9. indicate that the number of factors formed is determined by the initial eigenvalue, which is the amount of total variance that can be explained by the factors formed. Of the 13 factors, only 3 factors were formed because they had a total initial eigenvalue of more than one.

Table 9. Total Variance Explained Results

Factors	Initial Eigenvalues		
	Total	Variance (%)	Cumulative (%)
1	5,144	39,572	39,572
2	2,698	20,753	60,325
3	1,780	13,694	74,019
4	0,941	7,238	81,257
5	0,679	5,221	86,478
6	0,611	4,701	91,178
7	0,461	3,545	94,723
8	0,240	1,848	96,571
9	0,151	1,158	97,729
10	0,126	0,971	98,700
11	0,077	0,596	99,296
12	0,063	0,487	99,783
13	0,028	0,217	100,000

e. Rotation Process

The rotation process uses the Varimax method, which serves to clarify the factor structure by maximizing the loading value on one factor and minimizing cross-loading, so that Kansei Words can be more clearly grouped into the most relevant factors, which can facilitate the interpretation and utilization of factors in product design development [20]. The results of the rotated component matrix in Table 10. indicate that 13 Kansei Words have been grouped into factors formed based on the highest loading factor values. The loading factor value for each Kansei Word uses a minimum limit of 0.4, where a higher loading factor indicates a stronger correlation of the Kansei Word toward the factor [21].

Table 10. Rotated Component Matrix Results

No	Kansei Words	Factors		
		1	2	3
1	Sturdy	0,762	-0,036	0,466
2	Lightweight	0,609	0,180	0,453
3	Stability	0,886	0,133	0,206
4	Agility	0,889	-0,004	0,027
5	Trustworthiness	0,753	0,136	-0,368
6	Safe	0,222	0,889	0,058
7	Comfortable	0,263	0,907	0,125
8	Dignity	-0,100	0,654	0,503
9	Independence	-0,184	0,887	0,151
10	Concise	0,364	0,449	0,281
11	Modern	0,119	0,344	0,640
12	Stylish	0,136	0,036	0,858
13	Affirmation	0,080	0,249	0,888

Based on the placement of Kansei Words on the factors formed in Table 11, it can be seen that factor 1 consists of 5 Kansei Words, factor 2 consists of 5 Kansei Words, and factor 3 consists of 3 Kansei Words. The naming of the factors is determined based on the Kansei Word with the highest factor loading value, where factor 1 is named Agility, factor 2 is named Comfortable, and factor 3 is named Affirmation.

Table 11. Kansei Words Placement in the Identified Factors

Factors	Factors Names	Kansei Words	Loading Factor Value
Factor 1	Agility	Sturdy	0,762
		Lightweight	0,609
		Stability	0,886
		Agility	0,889
		Trustworthiness	0,753
Factor 2	Comfortable	Safe	0,889

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Factors	Factors Names	Kansei Words	Loading Factor Value
		Comfortable	0,907
		Dignity	0,654
		Independence	0,887
		Concise	0,449
Factor 3	Affirmation	Modern	0,640
		Stylish	0,858
		Affirmation	0,888

2. Conjoint Analysis

Conjoint analysis is a stage in research used to identify user preferences for various product design elements [20].

a. Stimuli Card Design Preparation

The stimuli card design consists of several combinations of 10 elements and 20 sub-elements of the rollator walker product, as shown in Table 12.

Table 12. Elements and Subelements of the Rollator Walker Product

Elements	Subelements
Material	Iron
	Aluminium
Number of Wheels	3 Wheels
	4 Wheels
Wheel Diameter	< 20 cm
	≥ 20 cm
Wheel Type	Solid Rubber
	Pneumatic
Brake System	Standard Hand Brake
	Push Brake
Seat and Backrest	With Seat and Backrest
	Without Seat and Backrest
Arm Rest	With Arm Rest
	Without Arm Rest
Supporting Accessories	With Supporting Accessories
	Without Supporting Accessories
Color	Achromatic
	Monochromatic
Seat Base Type	Firm
	Sling

The results of the stimuli card design preparation can be seen in Table 13.

Table 13. Stimuli Card Design

Card	Status	Material	Number of Wheels	Wheel Diameter	Wheel Type	Brake System	Seat and Backrest	Arm Rest	Supporting Accessories	Color	Seat Base Type
1	Design	Iron	4 Wheels	< 20 cm	Solid Rubber	Push brake	Without seat and backrest	With arm rest	Without supporting accessories	Monochromatic	Firm
2	Design	Iron	4 Wheels	≥ 20 cm	Pneumatic	Standard hand brake	With seat and backrest	Without arm rest	Without supporting accessories	Achromatic	Firm
3	Design	Aluminium	3 Wheels	≥ 20 cm	Solid Rubber	Standard hand brake	Without seat and backrest	With arm rest	Without supporting accessories	Achromatic	Sling
4	Design	Aluminium	3 Wheels	< 20 cm	Pneumatic	Standard hand brake	Without seat and backrest	Without arm rest	With supporting accessories	Monochromatic	Firm

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Card	Status	Material	Number of Wheels	Wheel Diameter	Wheel Type	Brake System	Seat and Backrest	Arm Rest	Supporting Accessories	Color	Seat Base Type
5	Design	Iron	3 Wheels	< 20 cm	Pneumatic	Push brake	Without seat and backrest	Without arm rest	Without supporting accessories	Achromatic	Sling
6	Design	Aluminium	4 Wheels	< 20 cm	Pneumatic	Push brake	With seat and backrest	With arm rest	With supporting accessories	Achromatic	Sling
7	Design	Aluminium	4 Wheels	< 20 cm	Solid Rubber	Standard hand brake	With seat and backrest	Without arm rest	Without supporting accessories	Monochromatic	Sling
8	Design	Iron	4 Wheels	≥ 20 cm	Pneumatic	Standard hand brake	Without seat and backrest	With arm rest	With supporting accessories	Monochromatic	Sling
9	Design	Aluminium	3 Wheels	≥ 20 cm	Pneumatic	Push brake	With seat and backrest	With arm rest	Without supporting accessories	Monochromatic	Firm
10	Design	Iron	3 Wheels	< 20 cm	Solid Rubber	Standard hand brake	With seat and backrest	With arm rest	With supporting accessories	Achromatic	Firm
11	Design	Aluminium	4 Wheels	≥ 20 cm	Solid Rubber	Push brake	Without seat and backrest	Without arm rest	With supporting accessories	Achromatic	Firm
12	Design	Iron	3 Wheels	≥ 20 cm	Solid Rubber	Push brake	With seat and backrest	Without arm rest	With supporting accessories	Monochromatic	Sling

b. Utility and Importance Values

The utility value indicates the total level of satisfaction users obtain from using a product, while the importance value indicates the design attributes that respondents consider most important in choosing a product [20]. Thus, the combination of utility and importance values can help researchers identify the most preferred sub-elements of rollator walker product design and the most important design elements of rollator walker products for the preferences of the elderly. The results of the utility value in Table 14. indicate that the design sub-elements of the rollator walker product were selected based on the highest utility value for each Kansei Word. The overall summary is the average utility value of the 13 Kansei Words that assess the level of satisfaction obtained by respondents for the development of the rollator walker product.

Table 14. Utility Value Results

No	Kansei Words	Utility Value									
		Material	Number of Wheels	Wheel Diameter	Wheel Type	Brake System	Seat and Backrest	Arm Rest	Supporting Accessories	Color	Seat Base Type
1	Sturdy	Iron	4 Wheels	< 20 cm	Pneumatic	Push brake	With Seat and Backrest	Without Arm Rest	With Supporting Accessories	Monochromatic	Firm
2	Lightweight	Aluminium	3 Wheels	< 20 cm	Pneumatic	Standard Hand Brake	Without Seat and Backrest	Without Arm Rest	Not Determined	Achromatic	Sling
3	Stability	Iron	4 Wheels	< 20 cm	Pneumatic	Push brake	With Seat and Backrest	Without Arm Rest	With Supporting Accessories	Monochromatic	Firm
4	Agility	Aluminium	4 Wheels	< 20 cm	Solid Rubber	Standard Hand	With Seat and Backrest	With Arm Rest	Without Supporting	Achromatic	Firm

No	Kansei Words	Utility Value									
		Material	**Number of Wheels**	**Wheel Diameter**	**Wheel Type**	**Brake System**	**Seat and Backrest**	**Arm Rest**	**Supporting Accessories**	**Color**	**Seat Base Type**
						Brake			Accessories		
5	Trustworthiness	Iron	3 Wheels	< 20 cm	Pneumatic	Push brake	With Seat and Backrest	With Arm Rest	With Supporting Accessories	Monochromatic	Sling
6	Safe	Aluminium	4 Wheels	< 20 cm	Solid Rubber	Push brake	With Seat and Backrest	With Arm Rest	With Supporting Accessories	Achromatic	Firm
7	Comfortable	Iron	4 Wheels	< 20 cm	Solid Rubber	Push brake	With Seat and Backrest	Without Arm Rest	Without Supporting Accessories	Achromatic	Firm
8	Dignity	Iron	3 Wheels	≥ 20 cm	Pneumatic	Standard Hand Brake	Without Seat and Backrest	With Arm Rest	Without Supporting Accessories	Achromatic	Firm
9	Independence	Iron	3 Wheels	< 20 cm	Pneumatic	Push brake	Without Seat and Backrest	With Arm Rest	Without Supporting Accessories	Achromatic	Sling
10	Concise	Iron	3 Wheels	< 20 cm	Pneumatic	Push brake	Without Seat and Backrest	With Arm Rest	With Supporting Accessories	Monochromatic	Firm
11	Modern	Iron	3 Wheels	≥ 20 cm	Pneumatic	Standard Hand Brake	With Seat and Backrest	Without Arm Rest	With Supporting Accessories	Achromatic	Sling
12	Stylish	Iron	4 Wheels	≥ 20 cm	Solid Rubber	Push brake	Without Seat and Backrest	With Arm Rest	With Supporting Accessories	Achromatic	Sling
13	Affirmation	Iron	4 Wheels	< 20 cm	Solid Rubber	Standard Hand Brake	With Seat and Backrest	Without Arm Rest	Without Supporting Accessories	Achromatic	Sling
Overall Summary		**Iron**	**4 Wheels**	**< 20 cm**	**Pneumatic**	**Push brake**	**With Seat and Backrest**	**With Arm Rest**	**With Supporting Accessories**	**Achromatic**	**Firm**

The results of the importance values in Table 15. indicate that the most important design elements of the rollator walker can be identified from the highest importance values in each Kansei Word. The overall summary shows the most important factors from lowest to highest in the design elements of the rollator walker.

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Table 15. Importance Value Results

No	Kansei Words	Importance Value (%)										
		Material	**Number of Wheels**	**Wheel Diameter**	**Wheel Type**	**Brake System**	**Seat and Backrest**	**Arm Rest**	**Supporting Accessories**	**Color**	**Seat Base Type**	**Most Important Factor**
1	Sturdy	48,898	12,576	2,926	5,053	5,737	1,558	8,169	4,293	8,169	2,622	**Material**
2	Lightweight	55,632	0,137	7,418	4,945	0,549	6,319	10,027	0,000	9,341	5,632	**Material**
3	Stability	5,190	71,058	5,190	0,200	0,200	1,996	5,190	6,986	1,996	1,996	**Number of Wheels**
4	Agility	0,528	3,379	78,669	2,957	0,950	5,808	0,528	1,901	1,901	3,379	**Wheel Diameter**
5	Trustworthiness	1,252	6,653	1,252	54,611	9,684	0,593	5,468	7,312	4,809	8,366	**Wheel Type**
6	Safe	0,805	0,805	0,805	7,246	57,327	7,246	8,857	7,246	0,805	8,857	**Brake System**
7	Comfortable	12,649	1,339	1,339	1,339	15,327	17,411	1,339	12,649	12,649	23,958	**Seat Base Type**
8	Dignity	4,181	8,053	15,965	0,870	5,471	4,461	8,782	11,364	18,547	22,306	**Seat Base Type**
9	Independence	8,187	3,592	6,600	8,187	15,121	8,187	33,250	6,600	3,592	6,683	**Arm Rest**
10	Concise	7,132	6,462	7,853	7,132	22,374	6,668	7,595	20,726	6,205	7,853	**Brake System**
11	Modern	10,364	6,219	13,631	1,696	18,907	1,696	8,103	16,520	21,168	1,696	**Color**
12	Stylish	13,842	4,789	2,789	3,842	1,421	9,105	4,263	3,842	54,684	1,421	**Color**
13	Affirmation	6,197	7,280	0,782	9,085	6,318	13,418	1,384	4,633	42,900	8,002	**Color**
Overall Summary		**13,451**	**10,180**	**11,171**	**8,243**	**12,261**	**6,497**	**7,920**	**8,006**	**14,367**	**7,906**	**Color**

c. Pearson's R and Kendall's Tau

Pearson's R and Kendall's Tau tests were used to measure the strength of the correlation between product design elements and Kansei Words [8]. Pearson's R and Kendall's Tau tests were used to measure the strength of the relationship between product design elements and Kansei Words [8]. The results of the Pearson's R and Kendall's Tau in Table 16. indicate that the Pearson's R and Kendall's Tau values for each Kansei Word are greater than 0,5 with a significance value of less than 0,05. Therefore, an overall summary shows that the correlation between the rollator walker product design elements and Kansei Word is strong.

Table 16. Pearson's R dan Kendall's Tau Test Results

No	Kansei Words	Pearson's R		Kendall's Tau		Remarks
		Value	**Sig.**	**Value**	**Sig.**	
1	Sturdy	0,999	< 0,001	0,992	< 0,001	Strong Correlation
2	Lightweight	1,000	< 0,001	1,000	< 0,001	Strong Correlation
3	Stability	1,000	< 0,001	0,902	< 0,001	Strong Correlation
4	Agility	0,999	< 0,001	0,933	< 0,001	Strong Correlation
5	Trustworthiness	0,996	< 0,001	0,926	< 0,001	Strong Correlation
6	Safe	1,000	< 0,001	0,913	< 0,001	Strong Correlation
7	Comfortable	0,953	< 0,001	0,933	< 0,001	Strong Correlation
8	Dignity	0,958	< 0,001	0,821	< 0,001	Strong Correlation
9	Independence	0,987	< 0,001	0,952	< 0,001	Strong Correlation
10	Concise	0,977	< 0,001	0,506	0,020	Strong Correlation
11	Modern	0,959	< 0,001	0,840	< 0,001	Strong Correlation
12	Stylish	0,985	< 0,001	0,744	< 0,001	Strong Correlation
13	Affirmation	0,998	< 0,001	1,000	< 0,001	Strong Correlation
Overall Summary		**0,987**	**< 0,001**	**0,969**	**< 0,001**	**Strong Correlation**

From the results of factor analysis and conjoint analysis, the subsystems (factors) and components (elements) of the rollator walker can be determined, as shown in Table 17.

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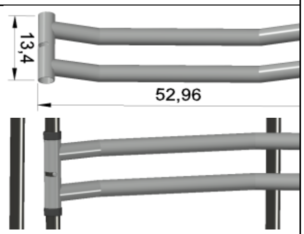
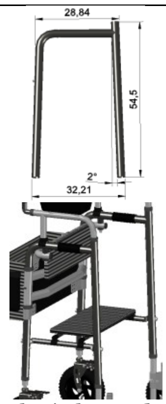
Table 17. Subsystems dan Components Rollator Walker

No	Subsystems	Components
1	Agility	Material
		Number of wheels
		Wheel diameter
		Wheel type
2	Comfortable	Brake system
		Seat and backrest
		Arm rest
		Supporting accessories
		Seat base type
3	Affirmation	Color

G. Detailed Design

The fourth stage of product development is detailed design, which involves specifying the shape, materials, and tolerances of all product components, and identifying all standard components [10]. The product dimensions used in the development of the rollator walker are based on anthropometric data of elderly people in Indonesia using the average percentile or P-50, as this represents the average size of elderly people in Indonesia. The body dimensions used as a reference for the development of the rollator walker product are elbow height, shoulder width (width of the shoulders/bi-deltoid width), hip width, sitting shoulder height, popliteal height, popliteal buttocks, hand width, hand length, and forearm length. Using these 9 body dimensions as a reference, a product mapping can be developed to translate emotional preferences into more detailed technical specifications, as shown in Table 18.

Table 18. Product Mapping Rollator Walker

Factors	Kansei Words	Subconcept (Level 1)	Subconcept (Level 2)	Subconcept (Level 3)	Subconcept (Level 4)	Design Specifications
Agility	Sturdy	Material	Iron	Rollator walker tube	OD= 3,2 cm ID = 2,9 cm	 This tube is used to connect the left and right frames of the rollator walker.
					OD= 2,8 cm ID = 2,5 cm	 This tube is located on the left and right frames of the rollator walker.

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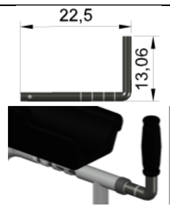
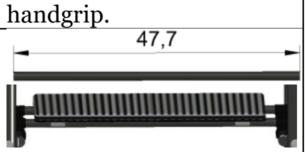
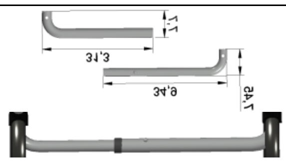
Factors	Kansei Words	Subconcept (Level 1)	Subconcept (Level 2)	Subconcept (Level 3)	Subconcept (Level 4)	Design Specifications
					OD= 2,3 cm ID = 2 cm	 The upper tube is connected to the arm rest. Meanwhile, the lower tube is connected to the wheels and brake lever.
					OD= 2 cm ID = 1,7 cm	 This tube is used to support the seat.
					OD= 1,8 cm ID = 1,5 cm	 This tube is used for the handgrip.
					OD= 1,5 cm ID = 1,2 cm	 This tube is used to connect the seat base to the rollator walker frame.
					Folding tube	 This tube is used to fold the rollator walker frame.
	Lightweight					

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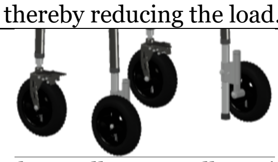
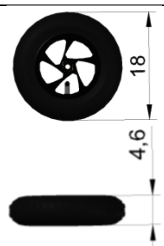
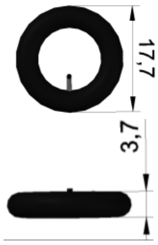
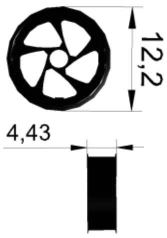
Factors	Kansei Words	Subconcept (Level 1)	Subconcept (Level 2)	Subconcept (Level 3)	Subconcept (Level 4)	Design Specifications
						The use of iron material is only focused on the rollator walker frame, thereby reducing the load.
	Stability	Number of wheels	4 Wheels			 The rollator walker is equipped with four wheels.
	Agility	Wheel diameter	< 20 cm (18 cm)			 The rollator walker is equipped with 18 cm diameter wheels.
	Trustworthiness	Wheel Type	Pneumatic	Regular tires	Outer tires	 Regular tires are equipped with outer tires.
					Inner tires	 Regular tires are equipped with inner tires that have schrader valve bent.
					Tire rims	  The tire rims are equipped with holes for schrader valve bent and bearing holes to support the wheel axles.

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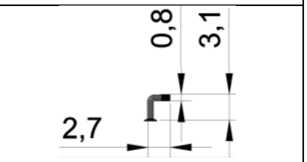
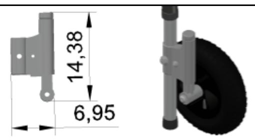
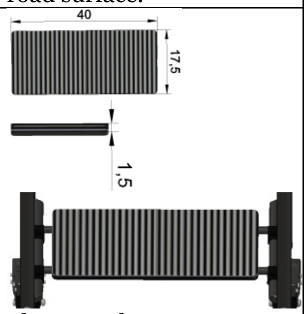
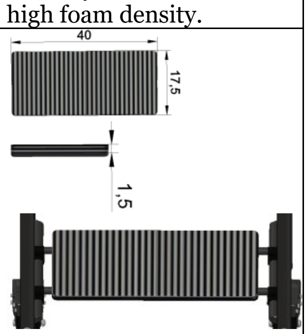
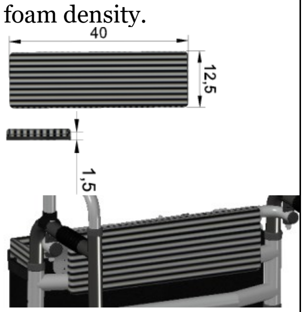
Factors	Kansei Words	Subconcept (Level 1)	Subconcept (Level 2)	Subconcept (Level 3)	Subconcept (Level 4)	Design Specifications
					Schrader valve bent	 The schrader valve bent is used to facilitate tire inflation.
Comfortable	Safe	Brake system	Push brake			 The push brake works by applying pressure to the rollator walker in a downward direction so that the tube with rubber pads creates friction on the road surface.
	Comfortable	Seat base type	Firm			 The seat base type uses memory foam firm with a high foam density.
		Seat and backrest	With seat and backrest			 The rollator walker seat is equipped with memory foam firm that has a high foam density.  The rollator walker backrest is equipped with

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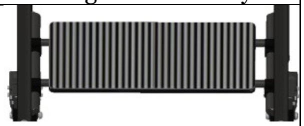
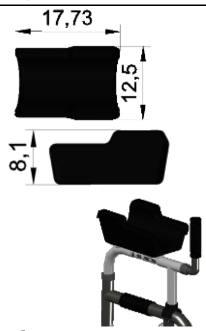
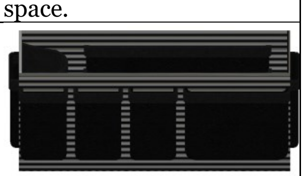
Factors	Kansei Words	Subconcept (Level 1)	Subconcept (Level 2)	Subconcept (Level 3)	Subconcept (Level 4)	Design Specifications
						memory foam firm that has a high foam density.
	Dignity	Seat base type	Firm			 The seat base type uses memory foam firm covered with black and white patterned nylon fabric.
	Independence	Arm rest	With arm rest			 The arm rests are used to support the lower arms when using the rollator walker.
	Concise	Brake system	Push brake			 The push brakes are equipped with a simple braking mechanism so they don't take up much space.
		Supporting accessories	With supporting accessories	Bag		 The open bag is used to store personal items.
Affirmation	Modern	Color	Achromatic			 The rollator walker has a combination of black, gray, and white colors.
	Stylishh					
	Affirmation					

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The overall design of the rollator walker product is shown in Figure 2.

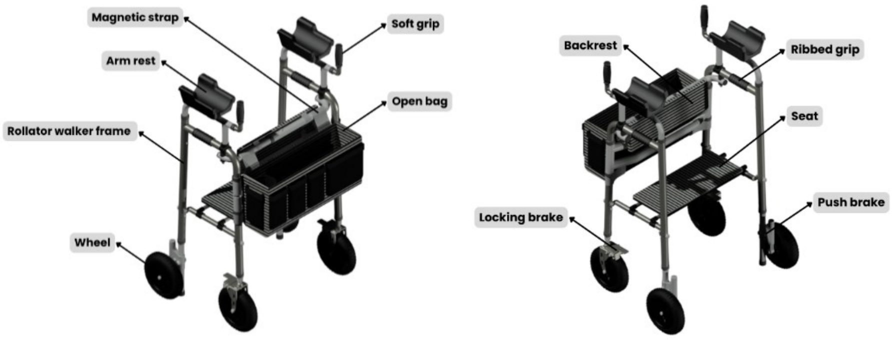

Figure 2. Product Design Rollator Walker

Based on the rollator walker product design that has been developed, a comparison was made between the standard walker product design used at the Hargo Dedali Nursing Home and the rollator walker product design developed from the standard walker, as shown in Table 19. The standard walker and rollator walker product designs can be seen in Figure 3.

(a) (b)
Figure 3. (a) Product Design Standard Walker (b) Product Design Rollator Walker

Table 19. Comparison of Standard Walker with Rollator Walker

No	Elements	Standard Walker	Rollator Walker	No	Elements	Standard Walker	Rollator Walker
1	Material	Made of aluminium material.	Made of iron material.	6	Seat and Backrest	It does not have a seat and backrest.	It has a seat and backrest.
2	Number of Wheels	It does not have wheels.	It has four wheels.	7	Arm Rest	It does not have arm rest.	It has arm rest.
3	Wheel Diameter	It does not have wheels.	It has wheels with a diameter of 18 cm.	8	Supporting Accessories	It does not have supporting accessories such as a bag or basket.	It has supporting accessories such as an open bag.
4	Wheel Type	It does not have wheels.	It has pneumatic wheels.	9	Color	It has achromatic colors.	It has achromatic colors
5	Brake System	It does not have a brake system.	It has a push brake system.	10	Seat Base Type	It does not have a seat and backrest, so it does not have a seat base type.	It has a firm seat base type.

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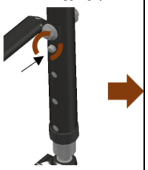
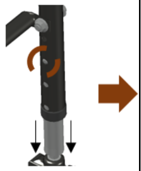
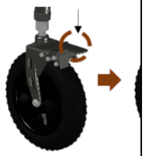
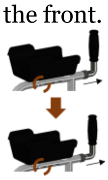
H. Testing and Repair

The fifth stage of product development is testing and refinement, which involves building and evaluating early production versions of the product [10]. In this study, simulations of rollator walker use were created with the help of artificial intelligence and visualized step by step using images from AutoCAD software, providing an overview of user interaction with the product without the need for direct testing, as shown in Table 20.

Table 20. Simulation of Rollator Walker Product Use

No	Mechanism	Operating Mechanism Description	Ilustration	No	Mechanism	Operating Mechanism Description	Ilustration
1	Adjustable tube to adjust the height of the rollator walker (OD = 2,3 cm & ID = 2 cm)	• Press the spring button inward. • Adjust the tube as needed.	• The spring button is pressed inward.  • The tube is adjusted as needed. 	5	Uses of the locking brake	• Apply pressure to the right locking brake lever downward until the rollator walker wheels are locked. • Apply pressure to the left locking brake lever downward until the right locking brake lever returns to the up position and the rollator walker wheels are unlocked.	• Apply pressure to the right locking brake lever downward.  • Apply pressure to the left locking brake lever downward. 
2	Adjustable tube to adjust the length of the tube handgrip (OD = 2,3 cm & ID = 2 cm)	• Adjust the tube towards the front.	• Adjust the tube towards the front. 	6	Sitting and standing form a seat base.	• Hold the ribbed grip.	• Hold the ribbed grip. 

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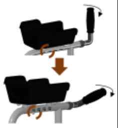
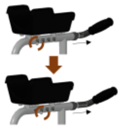
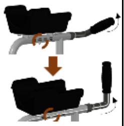
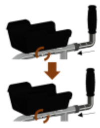
No	Mechanism	Operating Mechanism Description	Ilustration	No	Mechanism	Operating Mechanism Description	Ilustration
		• Rotate the tube until it reaches the maximum limit in the tube hole. • Adjust the tube towards the front as needed. • Rotate the tube back into the desired tube hole. • Adjust the tube backward to lock it in place. • Each size to adjust the length of the tube is marked with a white circle symbol	• Rotate tube.  • Adjust the tube towards the front.  • Rotate tube.  • Adjust the tube backward.  • The circle symbol is white. 			• The elderly can sit to rest while using the rollator walker and stand up again to continue using it.	• Sit or stand from the seat base of the rollator walker.  
3	Rollator walker movement	• Fold the seat base upwards.	• Fold the seat base.	7	Storage item personal	• Place personal items inside the open bag or in the	• Place personal items.

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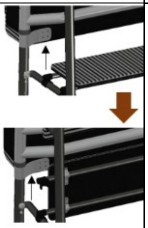
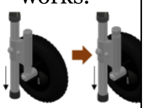
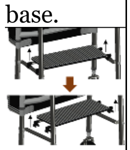
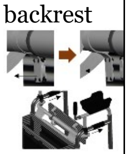
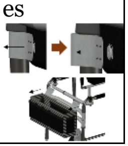
No	Mechanism	Operating Mechanism Description	Ilustration	No	Mechanism	Operating Mechanism Description	Ilustration
		• Pla ce the elderly's forearms on the arm rest. • Ho ld the soft grip that is on the tube handgrip. • Pu sh the rollator walker.	 • Pla ce the elderly's forearms on the arm rest.  • H old the soft grip.  • Pu sh the rollator walker. 			available pockets.	
4	Uses of the push brake	• Ap ply pressure on the rollator walker frame downwar ds with body weight. • Th e push brake works by applying friction to the road surface through rubber pads.	• Ap ply pressure downwar ds.  • Th e push brake works. 	8	Rollator walker folding	• Re move the tube of the seat base by pulling upwards. • Re move the backrest on the rollator walker by opening the magnetic strap. • Re move the supportin	• Re move the tube of the seat base.  • Re move the backrest  • Re move the supportin g accessori es 

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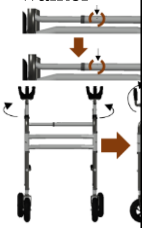
No	Mechanism	Operating Mechanism Description	Ilustration	No	Mechanism	Operating Mechanism Description	Ilustration
						g accessories such as an open bag from the rollator walker by opening the magnetic strap. • Press the spring button on the folding tube inward while folding the left and right frames of the rollator walker inwards. • The rollator walker can be folded according to specific needs for easy storage.	• Press the spring button while folding the frames of the rollator walker  • Storage of the folded rollator walker. 

After simulating the use of the rollator walker product, an evaluation was conducted using a questionnaire to assess respondents opinions of the initial product, which was a standard walker, and the product that had been developed from the standard walker, which was a rollator walker based on the Kansei Word factor. The results of the second questionnaire were tested using Stuart-Maxwell's Marginal Homogeneity test. Based on the results of the Stuart-Maxwell Marginal Homogeneity test in Table 21., it can be seen that the Asymp. Sig. (2-Tailed) value for the three Kansei Word factors is greater than 0,05; thus, there is no difference between the emotional needs of the elderly and the rollator walker design that has been developed from the standard walker.

Table 21. Marginal Homogeneity Stuart-Maxwell Test Results

No	Kansei Word Factors	Asymp. Sig. (2-Tailed)
1	Agility	0,074
2	Comfortable	0,061
3	Affirmation	0,059

Conclusion

Based on the research that has been conducted, it can be seen that the emotional needs of the elderly at the Hargo Dedali Nursing Home regarding the use of rollator walkers are represented in the form of 13 Kansei Words obtained through previous research, where each Kansei Word is related to a specific product element to explore the emotional preferences of the elderly, which will then be used as a basis for the development of rollator walker products. The results of the emotional preferences of the elderly at the Hargo Dedali Nursing Home were obtained after the rollator walker product sample assessment questionnaire results had undergone validity and reliability testing, factor analysis, and conjoint analysis. These emotional preferences point to the sub-elements of the rollator walker product that are most preferred by the elderly, where each sub-element of the rollator walker product is found in the product sample that has been previously assessed by the elderly. The results of the elderly's emotional preferences can be seen from the highest utility value. In developing the conceptual design of the rollator walker, the average anthropometric measurements of elderly people in Indonesia were used so that the product developed could meet ergonomic requirements. Each element of the rollator walker product is interrelated to fulfill the product development objectives of supporting independence and improving quality of life. Simulations of the use of the rollator walker product were created with the help of artificial intelligence and visualized in stages through image cutouts from AutoCAD software, providing an overview of the interaction between the user and the product without the need for direct testing. The product usage simulation consisted of 8 mechanisms, each of which was accompanied by a description of how it works and illustrations depicting the stages of product use. Further research is recommended to develop the rollator walker product design concept in the form of a prototype and to calculate the cost of developing the rollator walker product.

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