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Feasibility Analysis of Smart Wheelchairs Based on Voice Recognition for People with Disability

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ABSTRACT

Technological developments have accelerated the advancement of assistive technology, hence increasing human life feasibility. One of which is smart wheelchairs with a voice recognition to facilitate people with disability. However, from various smart wheelchair developments, there have been no detailed test results related to the efficiency analysis, the feasibility of the voice recognition feature on the smart wheelchair, and the satisfaction of users in using it. In this study, observations were conducted using a simple regression method, and test user satisfaction using the USE questionnaire. Based on calculation results, the learnability score was 78.81%, indicating that the wheelchair was easy to understand. The efficiency score was 85%, meaning that users found it easy to carry out their daily activities. The memorability score was 85%, indicating that it was easy to remember. The error score was 77.38%, meaning that smart wheelchairs were easy to use. The satisfaction score was 88.57%, meaning that the users felt very comfortable. The conclusion is users are satisfied with smart wheelchairs using voice recognition, meaning that it provides feasible use for a variety of people with disability. The results can be used as a foundation in continuing the development of technological features in smart wheelchairs.

1. Introduction

The development of science and technology has accelerated the development of assistive technology, hence increasing the level of human life feasibility. One of the assistive technologies is wheelchair technology. Wheelchairs are widely used by people with disability, people with leg injuries, and the elderly with gradually decreasing physical strength to walk. In particular, wheelchairs used for people with disability caused by restrictions in limb function, particularly the function of the legs (locomotor disability). Locomotor disability is a condition where there is damage or disorder in the shape or resistance of the bones, muscles, and joints to function normally [1]. This condition certainly hampers and reduces individuals' activities to stand or walk. Thus, the assistive technology wheelchair that is developed should be able to compensate for the physical limitation in movement in order to be active and productive.

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Currently, there are many types of wheelchairs on the market, ranging from conventional wheelchairs or manual wheelchairs to modern or smart wheelchairs. Even so, the use of conventional wheelchairs is less effective for people with disability in moving the wheelchair as it requires a large amount of power to pedal. With technological advancement, smart wheelchairs have been developed using a main sensor as an automatic controller that can make it easier for users. In addition, the advantages of smart wheelchairs greatly support the process of the endemic COVID-19 transition period in the application of physical distancing, because the movement of smart wheelchairs has been developed automatically so that it does not depend on other people in its use.

The innovations of smart wheelchair technology features that are applied include using a joystick or remote control. However, there are still many shortcomings for people who have limited physical movement such as hand movement. The limited movement experienced by users makes it quite difficult to control the joystick or remote control in an electric wheelchair. The solution to overcome these problems is to complete the features on the wheelchair with voice access technology as it does not require hand movements which may result in fatigue. Using this technology, wheelchairs are easier to control and move.

Voice recognition or known as speaker recognition is a technology designed to recognize who is speaking and functioned as a command to perform orders on the system [2]. The system converts humans voice so that they can be understood and spoken commands can be responded to by a controlled device using different acoustic characteristics of voices between individuals [3]. The existence of this voice recognition technology features has significantly facilitated human work in everyday life. Therefore, the feature of voice recognition technology is applied to the development of smart wheelchairs products.

In designing a technological product, it can be said that it fulfills its function and is helpful if it has been tested [4]. However, the development of various smart wheelchair products are not accompanied by detailed test analysis methods related to the feasibility analysis of the voice recognition feature on the smart wheelchair for users, the efficiency of the voice recognition feature, and the satisfaction of people with disability when using it. The absence of a feasibility and satisfaction analysis test method will lead to a lack of potential features in the use of a wheelchair, because it does not fulfill the function. Testing is inevitable in order to obtain the ideal voice recognition feature in order to obtain the level of efficiency, feasibility, and satisfaction on developing voice recognition features on smart wheelchairs for people with disability. In addition, it is expected that the obtained analysis results can contribute to current conditions and serve as a reference for future developments.

Based on this background, this research focuses on testing and analysis on the feasibility and user satisfaction of the voice recognition feature, the efficiency of the voice recognition feature on the smart wheelchair prototype designed by Ryan Prayudha [5] for people with disability from Himpunan Wanita Disabilitas Indonesia (HWDI). In its implementation, this research was conducted randomly and not influenced by gender and ergonomic values. The outline of the rest of the paper is organized as follows. Section 2 presents the related works about smart wheelchair based on voice recognition. Section 3 describes the simple regression analysis method and the USE Questionnaire method used in the data analysis of this research. Finally, future work is described in Section 5.

2. Literature Review

2.1. People with disability

Disability refers to the interaction between individuals with a health condition, personal, and environmental factors. The definition of disability is everyone who has physical, intellectual, mental, and/or sensory limitations in long period of time, hence experiencing difficulties when interacting with others or fully and effectively participating in events based on equality right [6].

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2.2. Assistive Technology

The application of organized knowledge and skills associated with assistive products, including systems and services, are assistive technology. This technology helps people to improve their capability to be more self-reliant. Examples of assistive products include hearing aids, wheelchairs, communication aids, eyeglasses, prostheses, pillboxes, and reminders [7]. The wheelchair with appropriate component with high feasibility allows users with physical disabilities to independently perform many daily activities. Providing the right wheelchair not only improves mobility, but also initiates the process of opening the world of education, work, and social life. A proper wheelchair not only ease the mobility, but also promotes the user's physical health and quality of life by improving breathing and digestion; and reducing common problems such as pressure ulcers and malformation progression.

2.3. Smart Wheelchair

Smart wheelchairs have been studied and developed since early 1980s [8]. Some smart wheelchairs work like autonomous robots. The smart wheelchair plans and execute the way to the destination. To reach the goal, the system requires navigation area. Smart wheelchairs nowadays choices of more "traditional" entrances methods related to motorized wheelchairs (e.g., joysticks and GPS tracker). Automatic voice recognition is often used in smart wheelchairs due to the low cost and wide availability of commercials speech recognition hardware and software. More input method has electrocardiographic activity to detect where wheelchair users are looking for or using computer vision calculation of head position and orientation.

Conventional wheelchairs are designed to allow people with leg disability to exercise by pushing the wheels of a wheelchair with their own hands. However, it can be an issue for those with hand disability as they are unable to push the wheels. For this reason, these conventional wheelchairs can be further developed using today's technology. Smart wheelchairs evolve over time, in line with technological development, the needs of people with disability, and future human goals.

2.4. Smart Wheelchair with Voice Recognition

Smart wheelchair typically consists of either conventional wheelchair base which a computer system or a collection of sensors. Wheelchairs are initially very useful for people with leg disability. In contrast, people who are unable to move their hands may find it difficult to uses wheelchairs [9]. After the increasing development of smart wheelchairs with technological developments, the optimal point of the system, speech recognition (e.g., recognition time and optimal decibels), and the feasibility of smart wheelchairs have not yet been determined. In this study, data were collected using purposive sampling method, then filling the optimal point with simple linear regression analysis and testing the feasibility of the smart wheelchair with voice recognition by using USE Questionnaire.

2.5. Purposive Sampling and Simple Linear Regression

Data collection is a systematic method for collecting and measuring data collected from various sources of information to find solutions or answers to relevant questions. Purposive sampling is a nonprobability sampling technique that relies on the discretion of the researcher to select variables in the sample population. Here, the entire sampling process depends on the researcher's judgment and knowledge of the context. When done properly, targeted sampling helps researchers rule out irrelevant answers that do not fit the context of the study. Once systematic research criteria based on specific goals have been developed, units or variables that can provide meaningful answers are selected. Purposive sampling can be thought of as a subset of convenience sampling, which respondents are chosen subjectively [10]. Data collection can be classified into two, namely primary data collection and secondary data collection. Primary data are raw data that are collected for the first time, while secondary data are data that are collected, tested, and published [11]. Simple regression analysis is a method to determine the causal relationship between one variable and another. Regression is a measure of the relationship between two or more variables expressed in the form of a function/relation [12]. Simple linear regression is used to test the degree of causality between the causal variable (X) and the effect variable. Causative factors are usually shown as X or predictors, and effect variables are shown as Y or reactions. Simple linear regression (SLR) is also one of the

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statistical methods used in production to forecast or predict the characteristics of quality and quantity. In this study, this method was used to calculate degree of causality of time respond and optimal decibel from the smart wheelchair with voice recognition to find the optimal point of this smart wheelchair.

2.6. Questionnaire Usefulness, Satisfaction, and Ease of Use (USE)

In this study, the USE Questionnaire was used as a measuring tool for get feasibility value. There are three aspects of measuring the feasibility of this questionnaire, namely easy of use (efficiency), usefulness, and satisfaction. [13] The USE Questionnaire was used to measure the level of user satisfaction with voice recognition-based smart wheelchairs and the feasibility of voice recognition-based smart wheelchairs for people with disability. There are many parameters other than those three aspects, but those aspects, especially learnability and satisfaction aspect, are easy parameters to be observed and compared the results [14]. The questionnaire that had been validated was tested for the reliability, through the calculation of the Cronbach's Alpha coefficient value [15]. In this study, The USE Questionnaire contained fourteen divided statements of five parameters (learnability, efficiency, memorability, error, satisfaction), each statement represents the user's current rating use the smart wheelchair.

3. Material and Methodology

3.1. Data

The sample data were collected from collaboration with HWDI located at Jalan Melati 1 No. 3 Manggala District, Makassar City, South Sulawesi Province. The number of samples taken was twenty users (had agreed on the attached consent letter). The sampling technique of this research was the purposive sampling method. Purposive sampling method is a sampling method by determining certain criteria on the sample [10]. The purposive sampling method in this study had following criteria.
1. Sample age range between 17–60 years old.
2. People with disability with a variety of physical disabilities.
3. Weight below 80 kg.

The main data source in this research was primary data. Primary data sources are data obtained directly from the community either through interviews, observations, and others to obtain complete information [11]. Primary data in this study was gathered through direct observation at the HWDI secretariat to obtain sample identity, various types of disability, weight, voice decibels, and level of satisfaction with the use of prototype of smart wheelchairs using voice recognition.

Data were calculated using a simple regression analysis method and the USE Questionnaire method. After that, data obtained from the instrument were analyzed with software and hardware using Windows 7 operating system and SPSS software.

3.2. Method

Fig. 1 Prototype of smart wheelchair-based voice recognition.

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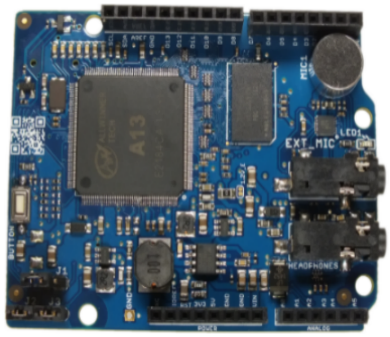

Fig. 2 MOVI Arduino voice shield.

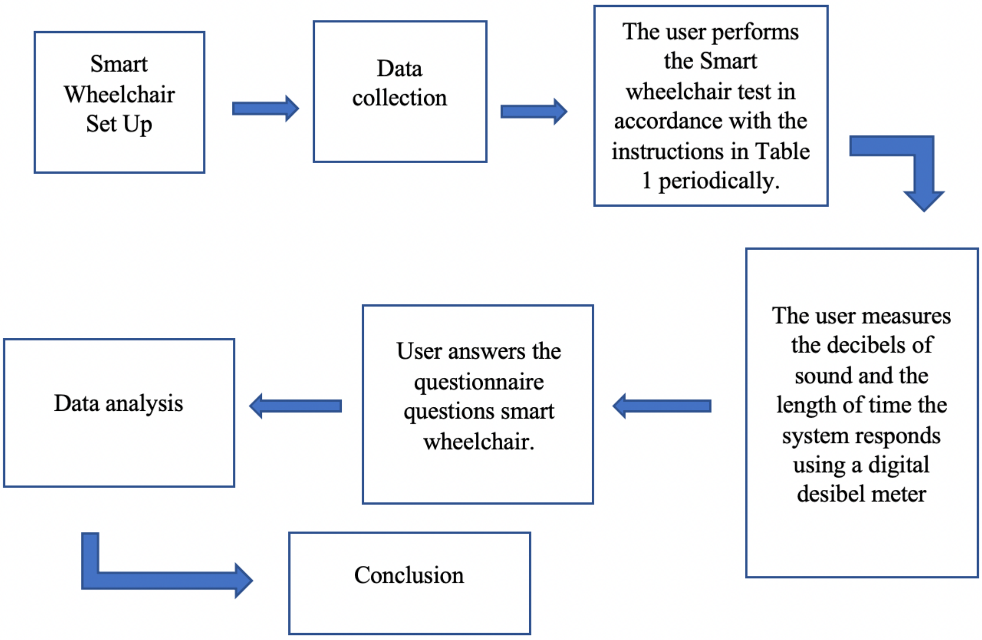

Fig. 3 Research flow.

Table 1. Voice Recognition Command Instructions

Instruction Input	Output/Feedback
"1 Forward"	The wheelchair responds to move forward.
"2 Go Back"	The wheelchair responds to go back.
"3 Right"	The wheelchair responds to turn right.
"4 Left"	The wheelchair responds to turn left.

After the data collection process was complete, the next step was to process data with the aim of analyzing the feasibility and user satisfaction of using smart wheelchair with voice recognition. The data processing was conducting using two methods: simple regression analysis method and USE questionnaire method.

3.2.1. Simple Regression Analysis Method

The calculated using a simple regression analysis method was used to find the optimal point of voice decibels after the smart wheelchair with voice recognition responded. Regression analysis is a method to determine the causal relationship between one variable and another. Regression is a measure of the relation between two or more variables expressed in the form of a function/relation [12].

A simple regression analysis formula [12] using (1) was applied to calculate the relationship between sound decibels and response time.

$$\boldsymbol{Y = a + bX} \quad (1)$$

the values of *a* and *b* can be calculated using (2) and (3).

$$\boldsymbol{a} = \frac{(\sum Y)(\sum X^2)-(\sum X)(\sum XY)}{n(\sum X^2)-(\sum Y)^2} \quad (2)$$

$$\boldsymbol{b} = \frac{n\sum XY-(\sum X)(\sum Y)}{n\sum X^2-(\sum X)^2} \quad (3)$$

Information:
Y = Response variable or dependent variable
X = Predictor Variable or Causative Variable (Independent)
a = constant
b = regression coefficient (slope); the amount of response generated by the predictor.

This study used simple linear regression analysis because the independent variable used was only one variable. The results of the calculation of the regression analysis could conclude how many decibels of voice so the performance of the smart wheelchair could be optimal. From this calculation, it was also possible to evaluate the performance of the smart wheelchair with a large decibel indicator of the user's voice.

3.2.2. USE Questionnaire Method

The USE questionnaire method was used to analyze user satisfaction of smart wheelchairs with voice recognition. The USE questionnaire is a form of subjective usability measurement questionnaire from research usability. The questionnaire used consisted of fourteen questions which were grouped into five dimensions: learnability, efficiency, memorability, error, and satisfaction [13]. The USE questionnaire was used to measure the level of user satisfaction and the feasibility with the smart wheelchair for people with disability.

The measurement of the feasibility analysis of this study referred to the formula feasibility measurement calculation [15].

$$Pk\ (\%) = \frac{\textbf{Observation Score}}{\textbf{Expected score}}\ \boldsymbol{x}\ \mathbf{100}\% \quad (4)$$

Before measuring the feasibility analysis, several tests were carried out. The steps in calculating the USE questionnaire are presented below:

a. Preparation of research instruments: instruments such as the device to be used and a list of questionnaire questions were prepared.

b. Questionnaire distribution: questionnaires were distributed to users who had tried the smart wheelchair with voice recognition.

c. Validity test: the validity test aims to find out whether items answered by the respondents have a valid or invalid correlation level. The validity test was conducted using (5).

$$\boldsymbol{r} = \frac{t}{\sqrt{df + t^2}} \quad (5)$$

where *df* is the degrees of freedom (*df* = n-2), *t* is the function to find the inverse of two – tailed, and *r* is the r-table person moment product correlation coefficient [15].

d. Reliability test: this test aims to determine the consistency of the measuring instrument, whether the measuring instrument used was reliable and remained consistent if the measurement was repeated. The reliability test in this study used the Cronbach Alpha formula [15].

$$\boldsymbol{r11} = \frac{n}{n-1}\left\{1 - \frac{\sum si^2}{st^2}\right\} \quad (6)$$

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Information:
$r11$ = Reliability coefficient
n = Number of questions
si^2 = The variance of the score of the question - i
st^2 = Total score variance

e. Analysis of the questionnaire processing results: Data processing was carried out after obtaining the results of the validity and reliability tests in accordance with the provisions. Data processing aims to measure the percentage value of the feasibility and satisfaction of smart wheelchair users based on voice recognition. In this study, the USE questionnaire was used. There are five dimensions: learnability, efficiency, memorability, error, and satisfaction. The questionnaire package can be seen in Table 2.

Table 2. USE Questionnaire Measurement Criteria

Learnability	**Efficiency**
The wheelchair is easy to understand about the working mechanism	The existence of this voice recognition system helps you get to work faster This system helps to mobilize users efficiently
This voice recognition is easy and clear to learn for users	
	The voice recognition when used is fast in translating the response
A smart wheelchair with voice recognition is easier to use than a manual wheelchair	
Memorability	**Error**
After finished using, this feature is still easy to remember to use	Never had any trouble when using the voice feature on a wheelchair
First time new user seeing smart wheelchair with sound	When used, the voice feature always responds
	The wheelchair voice recognition component is complete (full and comprehensive)
Satisfaction	
The desire to use the smart wheelchair back again. This smart wheelchair keeps up with technological developments This voice recognition works optimally in smart wheelchairs	

This questionnaire variable was measured using a 7-point Likert scale. Scale of 1 denotes strong dissatisfaction, while 7 denotes strong satisfaction.

f. Conclusion: The last stage in this study was drawing conclusions from the results of measuring feasibility and satisfaction using the USE questionnaire method that had been obtained. The standards of eligibility and satisfaction refer to the following values [15].

Table 3. Standards of Satisfaction and Eligibility.

Percentage value range (%)	Rating level
< 21	Very unworthy/very dissatisfied
21–40	Not worthy/not satisfied
42–60	Decent enough/satisfied enough
61–80	Worth/satisfied
80–100	Very worthy/very satisfied

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4. Results and Discussion

4.1. Result

The results of observations in the table below:

Table 4. Results of Sound Decibel Measurement

User	Decibels (dB)	Length of Time the Wheelchair processes Sound(s)
User 1	109.3	1.40
User 2	92.8	1.71
User 3	97.6	1.58
User 4	101.2	1.51
User 5	92.7	1.71
User 6	96.5	1.59
User 7	92.1	1.70
User 8	97.9	1.58
User 9	96.1	1.59
User 10	47.6	Not responding
User 11	67.2	Not responding
User 12	109.8	1.41
User 13	109.1	1.40
User 14	113.3	1.38
User 15	113.7	1.39
User 16	119.7	1.23
User 17	95.5	1.59
User 18	107.2	1.43
User 19	96.4	1.59
User 20	99.5	1.61

Table 4 show that voice decibels for users 10 and 11 were 47.6 dB and 67.2 dB, respectively. The smart wheelchair did not respond, so user 10 and user 11 were considered invalid. It can be concluded that the optimal interval of voice decibels for smart wheelchair with voice recognition was > 67.2 dB.

USER	Learnability			Efficency			Memorability		Error			Satisfaction			Score
	I	II	III	I	II	III	I	II	I	II	III	I	II	III	
User 1	5	5	6	5	6	5	5	5	4	4	5	6	6	6	73
User 2	6	5	5	6	6	7	5	4	5	6	6	7	7	6	81
User 3	6	5	7	5	6	6	7	6	6	6	5	6	7	7	85
User 4	4	5	7	7	7	7	7	7	7	7	6	7	7	7	92
User 5	5	6	4	6	5	6	6	7	5	4	5	4	6	5	74
User 6	4	2	7	7	7	6	7	7	7	4	5	7	7	6	83
User 7	6	5	7	5	6	6	7	7	6	6	5	6	7	5	84
User 8	6	5	5	6	6	7	5	4	5	6	6	7	7	6	81
User 9	6	5	7	5	6	5	6	6	5	4	5	6	6	6	78
User 10	6	6	6	5	6	6	6	7	6	1	5	6	7	7	80
User 11	5	5	6	6	6	5	5	6	5	1	5	6	6	6	73
User 12	5	6	6	5	6	6	6	7	6	5	6	6	6	6	82
User 13	6	6	6	7	6	6	6	6	7	6	6	7	7	6	88
User 14	6	5	5	6	6	5	6	6	5	6	6	6	6	6	80
User 15	6	5	6	6	5	6	6	6	6	5	6	6	6	6	81
User 16	6	5	5	6	6	6	5	6	5	5	6	6	6	5	78
User 17	6	6	6	6	7	7	6	6	6	6	6	6	6	7	87
User 18	6	6	5	6	6	6	5	6	6	6	6	6	7	7	84
User 19	6	5	5	6	6	6	6	5	6	6	6	5	6	6	80
User 20	6	5	5	6	6	5	6	6	5	6	6	6	5	6	79

Fig. 3 Questionnaire result data.

Based on the observations, the results of simple linear regression analysis were obtained, where the decibels of sound had a negative correlation with the length of time the smart wheelchair system responded. Meanwhile, in the USE questionnaire results, scores obtained for learnability, efficiency,

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memorability, error, and satisfaction were 78,81%, 85%, 85%, 77.38%, and 88.57%, respectively. These percentages were obtained using (4).

4.1.1. Simple Linear Regression Analysis

Table 5. Calculation Results of Simple Regression Analysis Correlation Test

Correlations			
		Decibel	***Duration***
Decibel	Pearson Correlation	1	-.977**
	Sig. (2-tailed)		.000
	N	18	18
Duration	Pearson Correlation	-.977**	1
	Sig. (2-tailed)	.000	
	N	18	18
** Correlation is significant at the 0.01 level (2-tailed).			

Table 5 shows that the voice decibel variable with the variable length of time for smart wheelchair sound processing had a correlation of -0.977. This result showed that these two variables had a very large negative correlation. The data were then continued in the calculation of regression analysis. From these results, it can be concluded that the greater the sound decibel, the longer the smart wheelchair based on voice recognition systems response time will be shortened.

Table 6. Model Results Summary

Model Summary			
Model	***R***	***R Square***	***Adjusted R Square***
1	.977a	.955	.952
Predictors: (Constant), Decibel			

Table 7. ANOVA

ANOVA				
Sum of Squares	***df***	***Mean Square***	***F***	***Sig.***
.295	1	.295	337,310	.000b
.014	16	.001		
.309	17			
a. Dependent Variable: Length of Time				

Table 10. Regression Coefficient

Coefficients				
Unstandardized Coefficients		***Standardized Coefficients***	***T***	***Sig.***
B	***Std. Error***	***Beta***		
3.113	.087		35.825	.000
-.016	.001	-.977	-18,366	.000
a. Dependent Variable: Length of Time				
b. Predictors: (Constant), Decibel				

The regression calculation was performed using model summary, ANOVA, and coefficients. The model summary concluded that the magnitude of the correlation (R) was 0.977. From the output, the coefficient of determination (R Square) was 0.955, meaning that the decibels of sound affect the sound processing time on the smart wheelchair based on voice recognition by 95.5%.

From the regression calculation, the constant a value was 3.113 and the regression coefficient *b* was -0.016, so that the regression equation was obtained.

$$\boldsymbol{Y = a + bX}$$

$$\boldsymbol{Y = 3.113 + (0.016)X}$$

The coefficient of -0.016 indicates that for every 1% addition of decibels will reduce the length of time by 0.016.

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From this equation, it is clear that the constant value of 3.113, meaning that the coefficient value of the variable length of time sound processing on the smart wheelchair was 3.113

4.1.2. USE Questionnaire Analysis

4.1.2.1 Validity test

Correlations

		x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	Y
x1	Pearson Correlation	1	.460*	-.311	-.369	-.394	-.045	-.302	-.421	-.266	.191	.277	-.129	-.103	-.024	-.045
	Sig. (2-tailed)		.042	.182	.109	.086	.850	.196	.064	.256	.421	.237	.587	.664	.920	.852
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
x2	Pearson Correlation	.460*	1	-.363	-.318	-.371	.101	-.310	.000	-.144	.037	.263	-.360	-.121	.160	.032
	Sig. (2-tailed)	.042		.116	.171	.107	.672	.184	1.000	.544	.877	.262	.119	.612	.502	.895
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
x3	Pearson Correlation	-.311	-.363	1	-.140	.484*	-.017	.623**	.385	.478*	-.073	-.421	.442	.354	.312	.432
	Sig. (2-tailed)	.182	.116		.555	.031	.943	.003	.094	.033	.761	.064	.051	.126	.180	.057
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
x4	Pearson Correlation	-.369	-.318	-.140	1	.330	.326	.076	.000	.478*	.290	.437	.361	.157	.037	.396
	Sig. (2-tailed)	.109	.171	.555		.155	.161	.749	1.000	.033	.215	.054	.118	.508	.878	.084
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
x5	Pearson Correlation	-.394	-.371	.484*	.330	1	.308	.302	.112	.425	.191	.082	.560*	.276	.467*	.550*
	Sig. (2-tailed)	.086	.107	.031	.155		.186	.196	.637	.062	.421	.731	.010	.239	.038	.012
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
x6	Pearson Correlation	-.045	.101	-.017	.326	.308	1	.096	-.167	.439	.425	.397	.331	.564**	.251	.619**
	Sig. (2-tailed)	.850	.672	.943	.161	.186		.687	.481	.053	.061	.083	.154	.010	.285	.004
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
x7	Pearson Correlation	-.302	-.310	.623**	.076	.302	.096	1	.639**	.658**	.226	-.262	.020	.220	.137	.549*
	Sig. (2-tailed)	.196	.184	.003	.749	.196	.687		.002	.002	.338	.264	.932	.350	.564	.012
	N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

Fig. 4 Validity test results.

Fig. 4 shows the results of the validity test conducted in this research.

4.1.2.2 Reliability Test

Table 11. Reliability Test

Reliability Statistics	
Cronbach's Alpha	*N of Items*
.646	14

Table 12. Results of the Smart Wheelchair Satisfaction and Feasibility Test with the USE Questionnaire Method

No	Question Dimension	Number of Items Valid	Max Score	Observation Score	Percentage	Average
1	Learnability	3	420	331	78.81%	5.52
2	Efficiency	3	420	357	85%	5.95
3	Memorability	2	280	238	85%	5.95
4	Error	3	420	325	77.38%	5.41
5	Satisfaction	3	420	372	88.57%	6.2

The above data were then compared with the value of the eligibility standard and satisfaction standard as in the table below [15].

Table 13. Satisfaction and Eligibility Standards

Percentage value range (%)	Conclusion
< 21	Very unworthy/very dissatisfied
21–40	Not worthy/not satisfied
42–60	Decent enough/satisfied enough
61–80	Worth/satisfied
80–100	Very worthy/very satisfied

Based on the r-table calculation for twenty respondents, a significant value of 5%, the r-table coefficient value was 0.4438. If each questionnaire item has a correlation value of more than 0.4438, then the status of the questionnaire item is declared valid. In contrast, if it is less than that value, the questionnaire item is declared invalid. Based on the calculations in Table 11, all calculated questionnaire items were greater than r-table. So, it can be concluded that all the data in this study were declared valid.

After testing the validity, then the reliability test was carried out by taking only valid questionnaire items for reliability analysis through the IBM SPSS Statistic tool to obtain Cronbach's Alpha values. The results of the reliability test can be seen in Table 12. This statistical test of reliability was compared with the reliability level of Cronbach's Alpha. The reliability test results obtained Cronbach's Alpha of greater than 0.6, so it can be concluded that all instruments in this study are reliable.

After the validity and reliability tests, the feasibility and satisfaction analysis were carried out. The results can be seen in Table 13. The standards of eligibility and satisfaction are shown in Table 14. Based on the calculation results of the satisfaction and feasibility of smart wheelchairs for people with disability, it was found that learnability score was 78.81%. It means that the smart wheelchair was easily understood by users. The efficiency obtained a value of 85%. This result suggests that it was very easy for the users to carry out their daily activities. Memorability got a score of 85%, indicating that, technically, the use of the smart wheelchair with voice recognition was easy to remember. The error score was 77.38%, meaning that errors rarely occurred so that users were easy to use smart wheelchairs with voice recognition. Satisfaction score was 88.57%, in this case people with disability using smart wheelchairs based on voice recognition felt very comfortable.

4.2. Discussion

After measuring the voice decibels which were processed using a simple regression analysis method, it was found that the decibels of voice were negatively correlated with the length of time the smart wheelchair system responded to sound. It shows that higher sound of the decibels voice emitted, the shorter the time it takes to process the system. However, from the results of the research data, it was found that the smart wheelchair did not respond when testing sounds were below 67.2 dB. It was due to an unfavorable situation when pronouncing instructions and of course it will be used as an evaluation material for further research on smart wheelchairs. Therefore, that there are no more obstacles for users who can only make sounds below than 67.2 dB.

From the results of the USE questionnaire analysis, it can be concluded that the user was satisfied with the performance of the smart wheelchair with voice recognition. In connection with that, it can also be concluded that the smart wheelchair with voice recognition is very suitable for people with disability, in this case with a variety of quadriplegic disabilities.

5. Conclusion

From the results of the regression analysis, it can be concluded that the decibels of sound have a high negative correlation with the length of time the smart wheelchair system responds to sound. It means that the higher the sound decibels, shorter time it needs to process the system. Meanwhile, from the results of the USE questionnaire analysis with five question dimensions, it can be concluded that the user was satisfied with the performance of the smart wheelchair with voice recognition.

Researchers still need to improve the study analysis of smart wheelchair with voice recognition technology in order to better understand the shortcomings of the smart wheelchair features. The weakness of the smart wheelchair is that it was unable respond to voice with sound decibels below 67.2 dB. It will certainly be very inefficient for users who can only make sound of no more than 67.2 dB.

The benefit of this research is that it can provide correct data in the development of smart wheelchairs with speech recognition technology that meet the demands of people with disability, as well as the appropriate size of sound decibels to ensure that the smart wheelchair works optimally. Suggestions for the development of smart wheelchair technology include paying more attention to the needs of people with disability so that technological products are more useful.

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