STABLENESS MEASUREMENT MODEL: A MATHEMATICAL APPROACH FOR MEASURING THE STABILITY OF HANDHELD APPLICATION USAGE

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ABSTRACT

This study is designed to develop a mathematical model for measuring the stability of handheld application usage namely Stableness Measurement Model (SMM). This model outlined a series of formulas based on the total number of eleven stability measures (i.e. eight stability metrics and three stability attributes) which are identified as having associated and contributed towards measuring the stability of handheld application usage. This model is valuable as an alternative evaluation technique to be used for measuring and ensuring the stability of handheld application usage.

KEYWORDS

Stability, model, measure, handheld, application

1. INTRODUCTION

Stability is one of the most fundamental and important of all usable and useful software characteristics. The term stability means making the condition of software of being resistant to change of position or condition with which not easily moved or disturbed [1]. Other definition described stability as quality or attribute of being firm and steadfast to software that bare on the provision of right or agreed results or effects with continuous function well in an acceptable period [2]. In this paper, the term stability in the perspective of useful and usable can be defined as the degree to which making the condition of software of being stable or steady in relation to correct or complete as well as effort and time, that reflects the real world object or event being described, based on the users' needs and requirements. The fewer failures and times taken to complete tasks that are observed the more stable an application is.

Stability normally plays an important factor for all software quality elements. Over the past few decades, several researches for assessing and evaluating stability of software have been mentioned. The international standard, ISO/IEC 9126 [2], described stability as quality sub attribute to software that bare on the provision of the ease with which a product can be maintained in order to improve reliability. In the other hand, stability correlates with the metrics which measure attributes of the software that indicate about the risk of unexpected effects as a result of modification [3][4][5]. Some researchers also classify stability as an essential characteristic for evaluating and assessing the usability of software [6][7][8][9]. Within the domain of handheld software, several researchers have proposed to explore the concept of stability [10][11][12][13].

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2. MATERIALS AND METHODS

This study outlined three main questions: 1) what stability measures are really important; 2) what is the rank of each stability measure; and 3) what is the weight of each stability measure, towards measuring the stability of handheld application usage. In order to answer these questions, a questionnaire survey, namely Investigating Stability Measures for Handheld Application Usage was conducted among handheld device users and a total number of two hundred nineteen respondents responded.

These stability measures were classified into three hierarchical levels of metrics, attributes and criterions. Metrics are described as the lowest hierarchy level. The main objective of the metrics is to identify measurable data for the purpose of measuring the stability of handheld application usages. The middle hierarchy level is described as attributes, whereas the highest is described as criterion (i.e. stability of handheld application usage). This hierarchy which brings together three different stability levels of metrics, attributes and criterion is as detailed below (Table 1).

Table 1. Stability hierarchy level

Hierarchy	**Description**
Metric	The lowest hierarchy level; A collection of measurable stability data expressed in units
Attribute	The middle hierarchy level; A collection of metrics which belongs to a class of stability measures
Criterion	The highest hierarchy level; A collection of attributes for measuring the stability of handheld application usage

A total number of eleven stability measures, with a number of eight stability metrics and three stability attributes, were outlined as having associated towards measuring the stability of handheld application usage. The definition of each stability measure is as depicted below (Table 2).

Table 2. Stability measures and descriptions

Measure	**Description**
Information Speed*	Capability in handling information per time
Lateral Position*	Capability in positioning objects per time
Optimal Solution*	Capability in solving tasks per time
Data Entered**	The number of data entered per time
Errors Corrected**	The number of errors corrected per time
Focuses Distracted**	The number of focuses distracted per time
Lines Read**	The number of lines read per time
Links Explored**	The number of links explored per time
Paths Traversed**	The number of paths traversed per time
Steps Navigated**	The number of steps navigated per time
Targets Located**	The number of targets located per time

Legend of the table:
* attribute determines the criterion (i.e. stability of handheld application usage)
** metric determines the attribute

Data collected from the questionnaire is entered in the Statistical Package for the Social Sciences (SPSS) for the analysis process as well as to classify the stability measures into the hierarchical structure of metrics, attributes and criterion. This brings together two parts of evaluation tests: Pearson's Chi-square test and the Spearman's Rho test. Pearson's Chi-Square test was conducted to measure the amount of association between two different stability measures in two different hierarchy levels and the Spearman's Rho test was conducted to comprehend the relationship strength between two different stability measures in two different hierarchy levels.

The model for measuring the stability of handheld application usage is specifically developed using a conceptual framework, namely Stableness Measurement Framework (SMF) (Figure 1). This framework brings together different stability measures in different hierarchy levels. As illustrated below, the metric determines the attribute and the attribute determines the criterion (i.e. stability as criterion). Each level represents interaction with other level and the impact to one another to measure the stability of the desired handheld application usage. This can be explained as either none, one or more metrics to represent a single attribute.

The combination of these metrics could be represented as the components that contributed to only one attribute. And finally, these attributes are used to support in the calculation of the criterion that can be concluded as directly affected the stability of handheld application usage. This is the case at every level in which could be represented as an M-1 relationship. For example, metric M_1 … M_n are the input to attribute A_A and criterion C_C is an output for the attribute A_A. Consider if the value of metric M_1, M_2, … , M_{n-1} or M_n increases so as the value of attribute A_A and criterion C_C. Again, if the value of metric M_1, M_2, … , M_{n-1} or M_n decreases so as the value of attribute A_A and criterion C_C.

3. RESULTS AND DISCUSSIONS

3.1. Results of Association Test

Result of association test reported that metrics of Data Entered (M = 4.52, SD = .738), Errors Corrected (M = 4.10, SD = .979) and Focuses Distracted (M = 3.65, SD = 1.027) were contributed towards measuring the stability of handheld application usage with $p < .001$. Results also showed that metrics of Links Explored (M = 4.25, SD = .780), Lines Read (M = 4.08, SD = .992) and Paths Traversed (M = 3.95, SD = .912) were contributed towards attribute Optimal Solution with $p < .001$. Meanwhile, metrics of Steps Navigated (M = 4.04, SD = .905) and Targets Located (M = 3.69, SD = 1.038)were also found contributed towards measuring the stability of handheld application usage with $p < .001$.

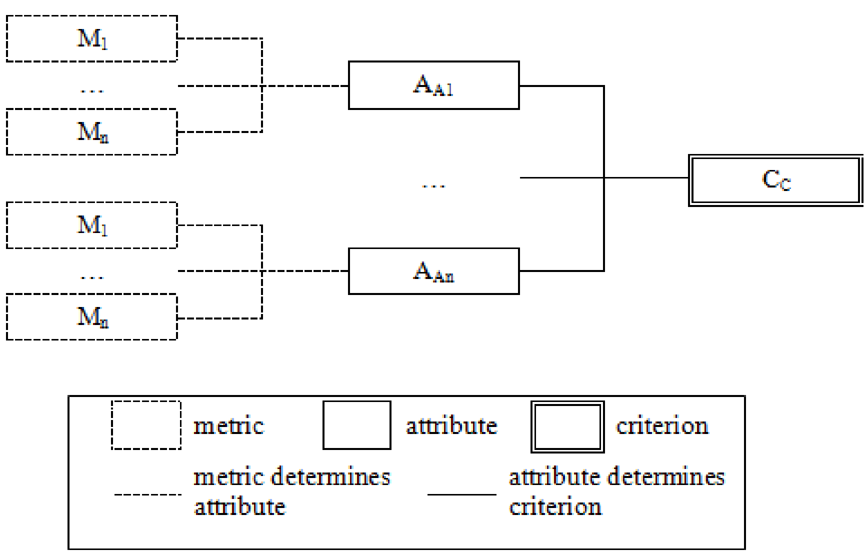

Figure 1. Stableness Measurement Framework (SMF)

Finally, result of the association test also stated that the attributes of Information Speed (M = 4.34, SD = .811), Lateral Position (M = 4.27, SD = .734) and Optimal Solution (M = 4.27, SD = .806) were found contributed towards measuring the stability of handheld application usage, with $p < .001$. As a result, a total number of eleven stability measures (i.e. eight stability metrics and three stability attributes) were identified having associated and contributed towards measuring the stability of handheld application usage (Table 3).

Table 3. Result of association test

Stability Measures	**Mean**
Stability Attributes	
Information Speed	4.34
Lateral Position	4.27
Optimal Solution	4.27
Stability Metrics	
Data Entered	4.52
Errors Corrected	4.10
Focuses Distracted	3.65
Lines Read Speed	4.08
Links Explored	4.25
Paths Traversed	3.95
Steps Navigated	4.04
Targets Located	3.69

Results from the association test were further ranked to prioritize the level of importance of each stability measure towards measuring the overall stability of handheld application usage (Table 4).

Table 4. Rank of stability measures

Stability Measures	**Rank**
Stability Attributes	
Information Speed	1
Lateral Position	2
Optimal Solution	3
Stability Metrics	
Data Entered	1
Links Explored	2
Errors Corrected	3
Lines Read	4
Steps Navigated	5
Paths Traversed	6
Targets Located	7
Focuses Distracted	8

3.2. Results of Relationship Test

Result of the relationship test revealed that there was a moderate and positive linear relationship between metrics Data Entered (R = .346), Errors Corrected (R = .251) and Lines Read (R = .298) towards attribute Information Speed with $p < .001$. Results also found that the coefficient value of metrics Targets Located (R = .528) and Focuses Distracted (R = .470) were moderate and positive linear relationship towards attribute Lateral Position with $p < .001$. Metrics Links

Explored (R = .333), Steps Navigated (R = .385) and Paths Traversed (R = .410) were also reported to have a moderate and positive linear relationship between attribute Optimal Solution with $p < .001$.

Finally, the relationship test also indicated the correlation strength between attributes Information Speed (R = .306), Lateral Position (R = .311) and Optimal Solution (R = .298) resulted having a moderate and positive linear relationship towards measuring the stability of handheld application usage with $p < .001$. Based on the result of the relationship test, out of the total number of eleven stability measures, seven (i.e. five stability metrics and two stability attributes) were identified having moderate and positive linear relationship, three (i.e. two stability metrics and one stability attributes) were identified having low and positive linear relationship, while only one stability matric reported having high and positive linear relationship towards measuring the stability of handheld application usage (Table 5).

Table 5. Result of relationship test

Stability Measures	**Relationship**
Attributes contributed towards criterion (attribute → criterion)	
Information Speed → Stability	Moderate, Positive
Lateral Position → Stability	Moderate, Positive
Optimal Solution → Stability	Low, Positive
Metrics contributed towards attribute (metric → attribute)	
Data Entered → Information Speed	Moderate, Positive
Links Explored → Optimal Solution	Moderate, Positive
Errors Corrected → Information Speed	Low, Positive
Lines Read → Information Speed	Low, Positive
Steps Navigated → Optimal Solution	Moderate, Positive
Paths Traversed → Optimal Solution	Moderate, Positive
Targets Located → Lateral Position	High, Positive
Focuses Distracted → Lateral Position	Moderate, Positive

Legend of the table: Correlation is significant at the 0.001 level (2-tailed) and range in the value of +1 to -1

Results from the relationship test were further analysed to obtain the value of weightage of each stability measure towards measuring the overall stability of handheld application usage (Table 6).

Table 6. Weight of stability measures

Stability Measures	Weight
Attributes contributed towards criterion (attribute → criterion)	
Information Speed → Stability	.306
Lateral Position → Stability	.311
Optimal Solution → Stability	.298
Metrics contributed towards attribute (metric → attribute)	
Data Entered → Information Speed	.346
Errors Corrected → Information Speed	.251
Lines Read → Information Speed	.298
Targets Located → Lateral Position	.528
Focuses Distracted → Lateral Position	.470
Links Explored → Optimal Solution	.333
Steps Navigated → Optimal Solution	.385
Paths Traversed → Optimal Solution	.410

The findings derived from the analysis of both association test and relationship test produced lists of codes to represent each stability metric and attribute, presented as $M_m \bullet A_a \bullet C_{STB}$ and $A_a \bullet C_{STB}$ respectively (Table 7). Symbolized as M_m, M represents the stability metrics while $_m$ represents the sequential series (m-th) of the stability metric such as 1, 2, …, m. Similarly, symbolized as A_a, A represents the stability attribute while $_a$ represents the sequential series (a-th) of the stability attribute such as 1, 2, …, a. Finally, symbolized as C_{STB}, C represents the stability criterion in which $_{STB}$ represents the abbreviation of the stability.

Table 7. Code of stability measures

Stability Measures	Code
Attributes contributed towards criterion (attribute → criterion)	$A_a \bullet C_{STB}$
Information Speed → Stability	$A_1 \bullet C_{STB}$
Lateral Position → Stability	$A_2 \bullet C_{STB}$
Optimal Solution → Stability	$A_3 \bullet C_{STB}$
Metrics contributed towards attributes (metrics → attributes)	$M_m \bullet A_a \bullet C_{STB}$
Data Entered → Information Speed	$M_1 \bullet A_1 \bullet C_{STB}$
Errors Corrected → Information Speed	$M_2 \bullet A_1 \bullet C_{STB}$
Lines Read → Information Speed	$M_3 \bullet A_1 \bullet C_{STB}$
Targets Located → Lateral Position	$M_1 \bullet A_2 \bullet C_{STB}$
Focuses Distracted → Lateral Position	$M_2 \bullet A_2 \bullet C_{STB}$
Links Explored → Optimal Solution	$M_1 \bullet A_3 \bullet C_{STB}$
Steps Navigated → Optimal Solution	$M_2 \bullet A_3 \bullet C_{STB}$
Paths Traversed → Optimal Solution	$M_3 \bullet A_3 \bullet C_{STB}$

Furthermore, findings derived from the analysis of both association test and relationship test also produced lists of codes to represent the weight of each stability metric and attribute, presented as ω_{ATTm} and ω_{CRTa} respectively (Table 8). ω represents the symbol of weights, meanwhile symbolized as $_{ATTm}$, $_m$ represents the sequential series (m-th) of the stability metric such as 1, 2, …, m that contributed towards particular attribute, $_{ATT}$, and finally symbolized as $_{CRTa}$, $_a$ represents the sequential series (a-th) of the stability attribute such as 1, 2, …, a that contributed towards measuring the stability of handheld application usage, in which $_{CRT}$ represents the abbreviation of the stability, coded as $_{STB}$.

Table 8. Weight code of stability measures

Stability Measures	Code
Attributes contributed towards criterion (attribute → criterion)	ω_{CRTa}
Information Speed → Stability	ω_{STB1}
Lateral Position → Stability	ω_{STB2}
Optimal Solution → Stability	ω_{STB3}
Metrics contributed towards attributes (metrics → attributes)	ω_{ATTm}
Data Entered → Information Speed	ω_{IS1}
Errors Corrected → Information Speed	ω_{IS2}
Lines Read → Information Speed	ω_{IS3}
Targets Located → Lateral Position	ω_{LP1}
Focuses Distracted → Lateral Position	ω_{LP2}
Links Explored → Optimal Solution	ω_{OS1}
Steps Navigated → Optimal Solution	ω_{OS2}
Paths Traversed → Optimal Solution	ω_{OS3}

4. STEADINESS MEASUREMENT MODEL

The analysis of association and relationship tests results the development of a model for measuring the stability of handheld applications usage, namely Stableness Measurement Model (SMM) (Figure 2).

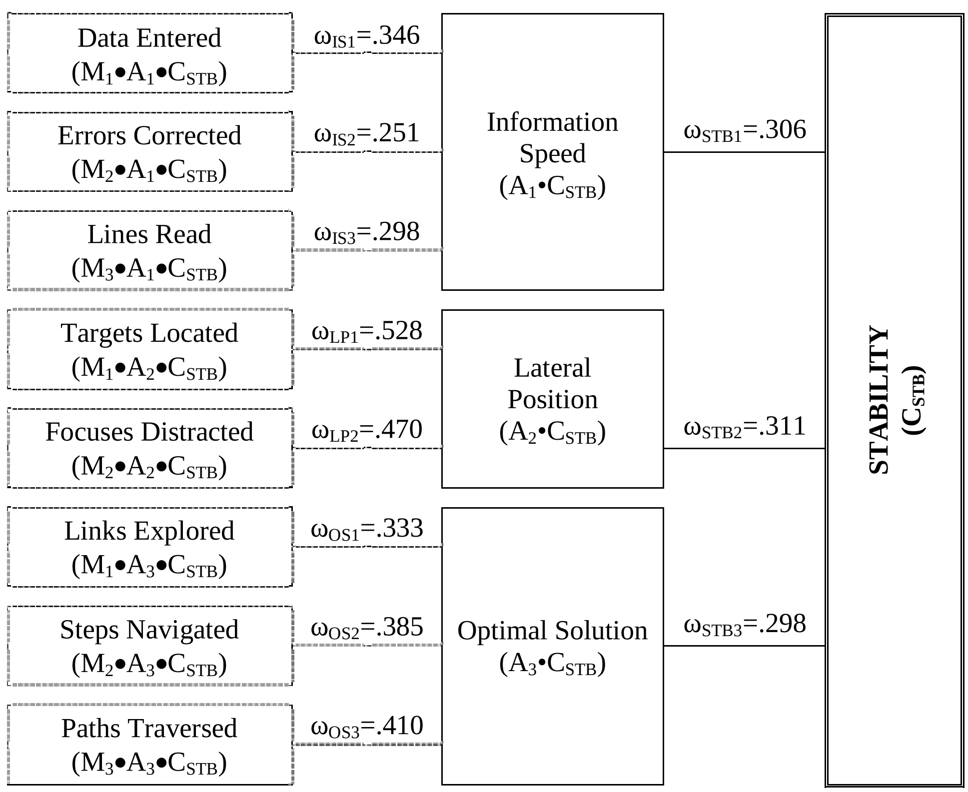

Figure 2. Stableness Measurement Model (SMM)

4.1. Measuring the Metrics

In order to measure the stability of handheld application usage, score for each metric can be formulated and calculated generally as the proportion of the difference between number of expected and actual activities occurred per time out of the total number of estimated activities occurred per time. Hence can be represented as

$$\text{Stability Metric } (M_{1\ldots m} \bullet A_{1\ldots a} \bullet C_{STB}) = \frac{\text{Number of actual activities occurred per time} - \text{Number of expected activities occurred per time}}{\text{Total number of expected activities occurred}} \quad (1)$$

Detail representation for measuring stability metrics Data Entered ($M_1 \bullet A_1 \bullet C_{STB}$), Errors Corrected ($M_2 \bullet A_1 \bullet C_{STB}$) and Lines Read ($M_3 \bullet A_1 \bullet C_{STB}$) that contribute towards attribute Information Speed ($A_1 \bullet C_{STB}$), thus can be referred as

$$\text{Data Entered } (M_1 \bullet A_1 \bullet C_{STB}) = \frac{\text{Number of actual data entered per time} - \text{Number of expected data entered per time}}{\text{Total number of expected data entered per time}} \quad (1.1a)$$

$$\text{Errors Corrected } (M_2 \bullet A_1 \bullet C_{STB}) = \frac{\text{Number of actual errors corrected per time} - \text{Number of expected errors corrected per time}}{\text{Total number of expected errors corrected per time}} \quad (1.2a)$$

$$\text{Lines Read } (M_3 \bullet A_1 \bullet C_{STB}) = \frac{\text{Number of actual lines read per time} - \text{Number of expected lines read per time}}{\text{Total number of expected lines read per time}} \quad (1.3a)$$

Detail representation for measuring stability metrics Targets Located ($M_1 \bullet A_2 \bullet C_{STB}$) and Focuses Distracted ($M_2 \bullet A_2 \bullet C_{STB}$) that contribute towards attribute Lateral Position ($A_2 \bullet C_{STB}$), thus can be referred as

$$\text{Targets Located } (M_1 \bullet A_2 \bullet C_{STB}) = \frac{\text{Number of actual targets located per time} - \text{Number of expected targets located per time}}{\text{Total number of expected targets located per time}} \quad (1.1b)$$

$$\text{Focuses Distracted } (M_2 \bullet A_2 \bullet C_{STB}) = \frac{\text{Number of actual focuses distracted per time} - \text{Number of expected focuses distracted per time}}{\text{Total number of expected focuses distracted per time}} \quad (1.2b)$$

Detail representation for measuring stability metrics Links Explored ($M_1 \bullet A_3 \bullet C_{STB}$), Steps Navigated ($M_2 \bullet A_3 \bullet C_{STB}$) and Paths Traversed ($M_3 \bullet A_3 \bullet C_{STB}$) that contribute towards attribute Optimal Solution ($A_3 \bullet C_{STB}$), thus can be referred as

$$\text{Links Explored } (M_1 \bullet A_3 \bullet C_{STB}) = \frac{\text{Number of actual links explored per time} - \text{Number of expected links explored per time}}{\text{Total number of expected links explored per time}} \quad (1.1c)$$

$$\text{Steps Navigated } (M_2 \bullet A_3 \bullet C_{STB}) = \frac{\text{Number of actual steps navigated per time} - \text{Number of expected steps navigated per time}}{\text{Total number of expected steps navigated per time}} \quad (1.2c)$$

$$\text{Paths Traversed } (M_3 \bullet A_3 \bullet C_{STB}) = \frac{\text{Number of actual paths traversed per time} - \text{Number of expected paths traversed per time}}{\text{Total number of expected paths traversed per time}} \quad (1.3c)$$

4.2. Measuring the Attributes

Score for each stability attribute can be formulated and calculated generally as the proportion of the accumulated product of attribute weight and the metric value out of the total of accumulated weight for each stability attribute. Hence can be represented as

$$\text{Stability Attribute } (A_{1\ldots a} \bullet C_{STB}) = \frac{\sum_{m=1}^{m=\max(m)} \omega_{ATTm} \; (M_{1\ldots m} \bullet A_{1\ldots a} \bullet C_{STB})}{\sum_{m=1}^{m=\max(m)} \omega_{ATTm}} \quad (2a)$$

which can be further expanded as

$$\text{Stability Attribute } (A_{1\ldots a} \bullet C_{STB}) = \left[\frac{\omega_{ATT1} (M_1 \bullet A_{1\ldots a} \bullet C_{STB})}{\omega_{ATT1} + \ldots + \omega_{ATTmax(m)-1} + \omega_{ATTmax(m)}} + \frac{\omega_{ATT2} (M_2 \bullet A_{1\ldots a} \bullet C_{STB})}{\omega_{ATT1} + \ldots + \omega_{ATTmax(m)-1} + \omega_{ATTmax(m)}} + \ldots + \frac{\omega_{ATTmax(m)-1} (M_{max(m)-1} \bullet A_{1\ldots a} \bullet C_{STB})}{\omega_{ATT1} + \ldots + \omega_{ATTmax(m)-1} + \omega_{ATTmax(m)}} + \frac{\omega_{ATTmax(m)} (M_{max(m)} \bullet A_{1\ldots a} \bullet C_{STB})}{\omega_{ATT1} + \ldots + \omega_{ATTmax(m)-1} + \omega_{ATTmax(m)}} \right] \quad (2b)$$

Detail representations for measuring stability attribute Information Speed ($A_1 \bullet C_{STB}$) that contribute towards measuring the stability of handheld application usage can be referred as

$$\text{Information Speed } (A_1 \bullet C_{STB}) = \frac{\sum_{m=1}^{m=3} \omega_{ISm} \; (M_m \bullet A_1 \bullet C_{STB})}{\sum_{m=1}^{m=3} \omega_{ISm}} \quad (2.1a)$$

hence can be further expanded as

$$\text{Information Speed } (A_1 \bullet C_{STB}) = \left[\frac{\omega_{IS1}\,(M_1 \bullet A_1 \bullet C_{STB})}{\omega_{IS1} + \omega_{IS2} + \omega_{IS3}} + \frac{\omega_{IS2}\,(M_2 \bullet A_1 \bullet C_{STB})}{\omega_{IS1} + \omega_{IS2} + \omega_{IS3}} + \frac{\omega_{IS3}\,(M_3 \bullet A_1 \bullet C_{STB})}{\omega_{IS1} + \omega_{IS2} + \omega_{IS3}} \right] \quad (2.1b)$$

which involved the proportion of the accumulated product of weight and value of each stability metrics Data Entered (ω_{IS1}[=.346] x $M_1 \bullet A_1 \bullet C_{STB}$), Errors Corrected ($\omega_{IS2}$[=.251] x $M_2 \bullet A_1 \bullet C_{STB}$) and Lines Read ($\omega_{IS3}$[=.298] x $M_3 \bullet A_1 \bullet C_{STB}$) that contribute towards attribute Information Speed ($A_1 \bullet C_{STB}$) divide by the total of attribute weights ($\omega_{IS1} + \omega_{IS2} + \omega_{IS3}$ = .346 + .251 + .298 = 0.895).

Detail representations for measuring stability attribute Lateral Position ($A_2 \bullet C_{STB}$) that contribute towards measuring the stability of handheld application usage can be referred as

$$\text{Lateral Position } (A_2 \bullet C_{STB}) = \frac{\sum_{m=1}^{m=2} \omega_{LPm} \; (M_m \bullet A_2 \bullet C_{STB})}{\sum_{m=1}^{m=2} \omega_{LPm}} \quad (2.2a)$$

hence can be further expanded as

$$\text{Lateral Position } (A_2 \bullet C_{STB}) = \left[\frac{\omega_{LP1}\,(M_1 \bullet A_2 \bullet C_{STB})}{\omega_{LP1} + \omega_{LP2}} + \frac{\omega_{LP2}\,(M_2 \bullet A_2 \bullet C_{STB})}{\omega_{LP1} + \omega_{LP2}} \right] \quad (2.2b)$$

which involved the proportion of the accumulated product of weight and value of each stability metrics Targets Located (ω_{LP1}[=.528] x $M_1 \bullet A_2 \bullet C_{STB}$) and Focuses Distracted (ω_{LP2}[=.470] x $M_2 \bullet A_2 \bullet C_{STB}$) that contribute towards attribute Lateral Position ($A_2 \bullet C_{STB}$) divide by the total of attribute weights ($\omega_{LP1} + \omega_{LP2}$ = .528 + .470 = 0.998).

Detail representations for measuring stability attribute Optimal Solution ($A_3 \bullet C_{STB}$) that contribute towards measuring the stability of handheld application usage can be referred as

$$\text{Optimal Solution } (A_3 \bullet C_{STB}) = \frac{\sum_{m=1}^{m=3} \omega_{OSm} \; (M_m \bullet A_3 \bullet C_{STB})}{\sum_{m=1}^{m=3} \omega_{OSm}} \quad (2.3a)$$

hence can be further expanded as

$$\text{Optimal Solution } (A_3 \bullet C_{STB}) = \left[\frac{\omega_{OS1}\,(M_1 \bullet A_3 \bullet C_{STB})}{\omega_{OS1} + \omega_{OS2} + \omega_{OS3}} + \omega_{OS2}\,(M_2 \bullet A_3 \bullet C_{STB}) + \right. \quad (2.3b)$$

$$\left. \frac{\omega_{OS3}\,(M_3 \bullet A_3 \bullet C_{STB})}{\omega_{OS1} + \omega_{OS2} + \omega_{OS3}} \right]$$

which involved the proportion of the accumulated product of weight and value of each stability metrics Links Explored (ω_{OS1}[=.333] x $M_1 \bullet A_3 \bullet C_{STB}$), Steps Navigated ($\omega_{OS2}$[=.385] x $M_2 \bullet A_3 \bullet C_{STB}$) and Paths Traversed ($\omega_{OS3}$[=.410] x $M_3 \bullet A_3 \bullet C_{STB}$) that contribute towards attribute Optimal Solution ($A_3 \bullet C_{STB}$) divide by the total of attribute weights ($\omega_{OS1} + \omega_{OS2} + \omega_{OS3}$ = .333 + .385 + .410 = 1.128).

4.3. Measuring the Criterion

Score for Stability (C_{STB}) can be formulated and calculated generally as the proportion of the accumulated product of criterion weight and the attribute value out of the total of accumulated weights for each stability criterion. Hence can be represented as

$$\text{Stability } (C_{STB}) = \frac{\sum_{a=1}^{a=3} \omega_{STBa} \quad (A_{1\ldots a} \bullet C_{STB})}{\sum_{a=1}^{a=3} \omega_{STBa}} \qquad \text{(3a)}$$

which can be further expanded as

$$\text{Stability } (C_{STB}) = \left[\frac{\omega_{STB1}\,(A_1 \bullet C_{STB})}{\omega_{STB1} + \omega_{STB2} + \omega_{STB3}} + \frac{\omega_{STB2}\,(A_2 \bullet C_{STB})}{\omega_{STB1} + \omega_{STB2} + \omega_{STB3}} + \frac{\omega_{STB4}\,(A_4 \bullet C_{STB})}{\omega_{STB1} + \omega_{STB2} + \omega_{STB3}} \right] \qquad \text{(3b)}$$

which involved the proportion of the accumulated product of weight and value of each stability attributes Information Speed (ω_{STB1}[=.306] x $A_1 \bullet C_{STB}$), Lateral Position (ω_{STB2}[=.311] x $A_2 \bullet C_{STB}$) and Optimal Solution (ω_{STB3}[=.298] x $A_3 \bullet C_{STB}$) that contribute towards measuring the stability of handheld application (C_{ACC}) divide by the total of criterion weights ($\omega_{STB1} + \omega_{STB2} + \omega_{STB3}$ = .306 + .311 + .298 = 0.915).

Score for Stability (C_{STB}) can be further analysed according to five distinct classifications as described below (Table 9). Prioritizing the stability of handheld application usage can be done by converting the values into words or sentences with which evaluators from various backgrounds and understanding can interpret the information accurately and comprehensively.

Table 9. Prioritizing stability level

Level	**Score** (C_{STB})	**Description**
1	$0.000 \le C_{STB} < 0.200$	Most badly absence or shortage of a desirable usage quality that attains stability level of unable to perform comprehensively
2	$0.200 \le C_{STB} < 0.400$	Lack of a desirable usage quality that attains stability level of the least excellent
3	$0.400 \le C_{STB} < 0.600$	Average of a desirable usage quality that can be tolerable to consider good enough
4	$0.600 \le C_{STB} < 0.700$	Complete the specific requirements of a desirable usage quality that achieves stability level of almost in a state of being practical
5	$0.800 \le C_{STB} \le 1.000$	Fulfil all the requirements of a desirable usage quality that achieves stability level of very high distinction of proficiency

5. CONCLUSIONS

The model developed not only reveals the stability between handheld users and its application but also provide a better understanding on the relationship of these factors. In addition, this model can be established as a concrete evaluation technique for measuring the stability of handheld application usage. For the future, it is recommended to evaluate cases between the stability model and the actual handheld applications. With extensive experiences, stability measures might change and additional new criteria could be included in the future work. Therefore, the model developed need to be refined practically through many applications in the real work environment.

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