Evalution Model of Website Usability

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Abstract. Website construction has been paid high attention from all walks of life. To seek a scientific and reasonable website usability evaluation method is increasingly important. By using the basic theory of usability engineering we have established the evaluation index system of website usability, and website usability quantitative evaluation method is presented based on the grey relational analysis. This method can also solve the comprehensive evaluation problems about design quality of system which conclude unknown or uncertain information.

1. Preface

With the popularity of Internet technology, all walks of life are setting up or have established their own website. Website usability is directly related to the user’s experience level of the site, which affect the market competitiveness of website [1]. Website usability evaluation depend on the establishment of evaluation index system and scientific and quantitative evaluation method, to make quantitative analysis and evaluation about the degree of the website availability , providing reference basis of establishing website or selecting website.

Website usability connotation is quite rich, mainly refering to the following four aspects: (1) The content of the website contains the design of the interface and technical level of system; (2) The estimator is a person, who make the subjective evaluation by finishing various operating tasks as a user; (3) The website is targeted. For different users and domain, the evaluation index and parameter are different; (3) Website has the function of error correction. The user can complete the operation task under abnormal operation. So the website usability evaluation has certain subjectivity, which is partially known factors interact with some unknown factors.

A grey system is known as a system containing unknown or uncertain information, and the relational analysis is called the Grey Relational Analysis [2]. Website usability evaluation problem has the typical characteristics of gray system, and is suitable for comprehensive evaluation using the grey relational analysis method.

2. Evaluation method

2.1. The choice of website usability evaluation factors
Selecting the main factors influencing the website usability to make evaluation. We select information content, interface design, navigation design, application conditions, and subjective satisfaction the five elements as evaluation factors [1].

2.2. To determine the value of website usability evaluation factors
According to the user survey statistics, combined with the suggestions of experts to determine the weights \( p_k \) of evaluation factors.
2.3. Set up grey evaluation model of website usability

The basic principle of grey relational method is based on geometrical similarity of the contrast between a family of curves setting by sequence and curves in the composition of the reference sequence, to ensure and compare relational degree between sequence set and reference sequence. Comparing the curves of the sequence and the reference sequence, the more similar the geometry is, the greater the degree of relational, and vice versa. It is equally applicable to the number of samples and there are no laws, and has a small amount of calculation, which is very convenient. There will be no situation that the quantitative results are not in conformity with the qualitative analysis results. The specific calculation method and the steps as follows [3].

**Step 1**: identify the reference sequence and compared sequence

The data series reflecting the characteristics of the system behavior, is system evaluation standard, known as the reference sequence, denoted by \( x_0 = \{ x_0(k) | k = 1, 2, \cdots, n \} \). The reference sequence should select the best performers from all of the design target, when the index belong to "efficiency", to select the maximum value of the index in all the programs; When the index belong to "cost", to select the multiplicative inverse of the minimum value of all the alternatives. The data sequence which combined with factors that affecting the behavior of the system, that is to be evaluated in the system, is known as comparative sequence, denoted by \( x_i = \{ x_i(k) | k = 1, 2, \cdots, n \}, i = 1, 2, \cdots, m \).

**Step 2**, the nondimensionalization of variable quantity

The different dimension of data in all factors in the system may be different that affect the conclusions and even harder to obtain a correct conclusion, so in order to make the conclusion with sufficient reliability, when in the grey relational degree analysis, we are generally required to dimensionless processing of data. \( x_i(k) \) is still showed as \( x_i(k) \) after the nondimensionalization. There many kinds of methods of nondimensionalization. We selected following ways to carry on nondimensionalization:

\[
x_i(k) = \frac{x_i(k)}{x_i(1)}, \quad k = 1, 2, \cdots, n; \quad i = 1, 2, \cdots, m.
\]

(1)

**Step 3**, to calculate the relational coefficient of \( x_0(k) \) and \( x_i(k) \)

\[
\zeta_i(k) = \frac{\min \min |x_0(k) - x_i(k)| + \rho \max \max |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max \max |x_0(k) - x_i(k)|},
\]

(2)

Denoted by \( \Delta_i(k) = |x_0(k) - x_i(k)| \), then

\[
\zeta_i(k) = \frac{\min \min \Delta_i(k) + \rho \max \max \Delta_i(k)}{\Delta_i(k) + \rho \max \max \Delta_i(k)}.
\]

\( \rho \in (0, \infty) \) is named as distinguish coefficient. The smaller the value of \( \rho \) is, the greater the resolution is. Generally the value of \( \rho \) is commonly between \( (0, 1) \), here \( \rho = 0.5 \).

\( \zeta_i(k) \) is the correlation coefficient of the \( k \) element of the comparative series \( x_i \) and the \( k \) element of the reference sequence \( x_0 \).

Because the correlation coefficient is a correlation degree of sequence and reference value in every moment, and there are many such values, it is not easy to compare the whole. We can use the weighted average method to centralized information as the total number representation to compare relevance between comparison sequence and reference sequence. The correlation formula \( r_j \) is as follows:
\[ r_i = \sum_{k=1}^{n} p_i \xi_i^r(k), i = 1, 2, \ldots, m. \] (3)

**Step 4**, the repartition of the correlation degree ranking and grade

According to the size of the order sort, if \( r_1 < r_2 \), the correlation between reference number \( x_0 \) and the comparison sequence \( x_2 \) is greater than \( x_1 \). Accordingly, the website usability is stronger.

The correlation degree is divided into 4 sections to determine the correlation level. The specific is in table 1 [4]

| Grade                  | Relevancy | Evaluation description                        |
|------------------------|-----------|----------------------------------------------|
| Low correlation        | 0–0.3     | Weak coupling between two indexes            |
| Moderate correlation   | 0.3–0.6   | The coupling effect between the two indexes is moderate |
| Higher correlation     | 0.6–0.8   | Strong coupling effect between the two indicators |
| High correlation       | 0.8–1     | The relative changes of the two indexes are almost the same, and the coupling effect is very strong. |

### 3. Application and discussion

Assuming that there are three website designs, we need to evaluate their usability. We select information content, interface design, navigation design, application conditions and subjective satisfaction as assessment factors. The weights of website assessment factors confirmed by experts are shown in table 2.

| factor of evaluation (k) | information content | UI | navigation design | application conditions | subjective satisfaction |
|--------------------------|---------------------|----|-------------------|------------------------|------------------------|
| Evaluation weight \( p(k) \) | 0.25 | 0.20 | 0.20 | 0.10 | 0.25 |

To take system of 10 minutes for the evaluation factors, and making the questionnaire survey of the users and statistical data. To get the evaluation factors of the evaluation factors of the score, which is seen in Table 3.

| factor of evaluation | information content | UI | navigation design | application conditions | subjective satisfaction |
|---------------------|---------------------|----|-------------------|------------------------|------------------------|
| Program A           | 10                  | 8  | 8                 | 6                      | 10                     |
| Program B           | 8                   | 8  | 6                 | 10                     | 6                      |
| Program C           | 10                  | 6  | 8                 | 8                      | 8                      |

To evaluate the three website design programs.

The number list of three kinds of programs are being compared are

\[ x_1 = \{10, 8, 8, 6, 10\} \]

\[ x_2 = \{8, 8, 6, 10, 6\} \]

\[ x_3 = \{10, 6, 8, 8, 8\} \]

The above sequence substituted into the formula (1), (2), (3), is calculated to

\[ r_1 = 0.756, r_2 = 0.705, r_3 = 0.727 \].
According to the correlation degree shown in Table 1, these three programs are in a strong level of coupling with the standard program, and each has its own advantages. Comprehensive evaluation results show that \( r_1 > r_2 > r_3 \). On the whole, the coupling between program A and the standard scheme is the strongest, and is the most close to the standard program, so the program a website design is optimization.

4. Conclusion
Grey relational analysis method is applied in this article. Through the integration from qualitative analysis to ration analysis, we make comprehensive evaluation of the availability of the web site's design. Scientific and reasonable, simple and feasible, this method can also solve synthetic evaluation problems in which many factors interact with each other containing unknown or uncertain information system.

5. References:
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