New usability evaluation model for a personalized adaptive media search engine based on interface complexity metrics

2012 NEM Summit, Oct. 16-18, Istambul, Turkey

Silvia Uribe, Federico Álvarez, José Manuel Menéndez
E.T.S.I de Telecomunicación, UPM, Spain
1. Introduction (I)

- The data digitalization has caused an enormous content increase over networks and devices. Users not only... consume these contents: CONSUMERS

but produce them: PROSUMERS

- New multimedia search engines help to manage and find specific contents, but we need usable solutions to do these tasks in an easier and faster way.
1. Introduction (II)

- The success of an application is only assured if it represents a good solution in terms:
  - Effectiveness,
  - Efficiency
  - User’s satisfaction

- Usability evaluation types:
  - **Summative evaluation**: after the implementation (eg. users’ surveys, thinking aloud…). Disadvantage: the **high cost (time and money)** of changing the application after the implementation.
  - **Formative evaluation**: before the implementation, over a prototype (eg. heuristics methods, predictive metrics…). Typical disadvantage with heuristics method: they have to be **applied by usability experts**, increasing the application costs.
1. Introduction (II)

- A new usability evaluation model is proposed:
  - It is applied before the implementation is done.
  - Can be done by non-experts on usability.
  - reducing the application costs
  - generalizing its use

- Applied on a new search engine called BUSCAMEDIA:
  - It provides a novel solution to access a wide amount of data.
  - It needs an adaptive, personalize and USABLE interface to provide its function.
2. Overview of BUSCAMEDIA

- A new semantic search engine for multimedia content

- Main characteristics:
  - Based on M3 Ontology: multilingual, multidomain and multimedia.
  - Searching process through natural language.
  - Dynamic adaptation to any network, device, context and user.
  - Automatic adapted content generation.
  - Based on cloud computing: faster and more efficient.
We propose a new usability evaluation model, focused on the usability evaluation in the design process.
3. New Usability Evaluation Model (II)

• Its main characteristics are:
  - It includes an additional usability evaluation stage before the implementation (formative evaluation).
  - It applies a set of complexity metrics to determine the usability level of the solution.
  - A new weighting method is applied to provide a global result for the usability level.

- It helps to improve the solution quality
- It reduces costs in terms of time and money
- It can be applied by non-usability experts
- Based on the optimization of metrics’ adjustment according to users’ opinion

7 October 16-18, 2012
NEM Summit
4. Interface Evaluation (I)

- BUSCAMEDIA’s interface to be evaluated:

Interface

Interface’s diagram
(It facilitates the interpretation of the data analysis in interface aesthetics)
4. Interface Evaluation (II)

• Based on **complexity metrics**:

  • **Size complexity CS**: \( CS = 1 - \frac{\sum_{i=1}^{n} (n_{\text{size}} - 1)}{n} \in [0,1] \)
    
    • In charge of categorizing the interface’s elements into groups according to their different sizes. In this case, \( n_{\text{size}} = 15 \) and \( n = 24 \), so \( CS = 0.416 \).

  • **Local Density LD**: \( LD = 1 - 2 \left( 0.5 - \frac{\sum_{i=1}^{n} a_i}{a_{\text{frame}}} \right) \in [0,1] \) where \( a_i \) and \( a_{\text{frame}} \) are the areas of object \( i \) and the frame
    
    • It is in charge of evaluating the density of the interface, considering 50% the optimal result for graphic screens. In this case, taking into account the interface and main elements’ (no. 1, 23, 24) sizes, \( LD = 0.484 \).
4. Interface Evaluation (III)

- **Group complexity CG**: \( CG = \frac{g_i}{g} \in [0,1] \) where \( g_i \) represents the number of groups with a clear boundary and \( g \) is the total number of groups.

  - It is in charge of determining the grouping complexity of similar graphical elements. In this case every object of the interface is grouping with similar elements by a clear boundary line, so \( GC=1 \).

- **Alignment complexity AS**: \( AS = \frac{3}{n_{vap} + n_{hap} + n} \) where \( n_{vap} \) and \( n_{hap} \) are the number of vertical and horizontal alignment points.

  - It is in charge of determining the different alignment points. In this case there are 14 different horizontal alignment, 22 vertical and 24 elements in total, giving an \( AS=0.05 \).
4. Interface Evaluation (IV)

- The global result of usability level of the solution can be obtained by:
  - Calculating the metrics average
  - Applying a new obtained weighting process

Every metric has the same importance in the user’s opinion

It differs from the user’s evaluation done by F. Fu et al.

Each metric has a different impact on the user’s opinion
4. Interface Evaluation (V)

- For obtaining the **weighting coefficients**:
  - We obtained the **correlation** between the user’s opinion and the metrics results in the research work by F. Fu et al.: \( corr[CS, LD, CG, AS, Users] \)
  - We determined **which metric has the bigger importance** for the user: CG. \( \max(corr) = corr(CG, Users) \)
  - We provide a **different coefficient for each metric** taking into account the lineal relationship between them according to the correlation matrix.

\[
CS = \frac{corr(CS, Users)}{corr(CG, Users)} = 0.68 \\
LD = \frac{corr(LD, Users)}{corr(CG, Users)} = 0.24 \\
AS = \frac{corr(AS, Users)}{corr(CG, Users)} = 0.69
\]
The obtained coefficients are: 

\[ \text{CG}=38\%, \ \text{CS}=26\%, \ \text{LD}=9\%, \ \text{AS}=27\%. \]

Applying these coefficients, the usability evaluation results are:

<table>
<thead>
<tr>
<th>CS</th>
<th>LD</th>
<th>CG</th>
<th>AS</th>
<th>Metric’s average</th>
<th>Weighting process</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.41</td>
<td>0.49</td>
<td>1</td>
<td>0.05</td>
<td>0.48</td>
<td>0.54</td>
</tr>
</tbody>
</table>

The obtained results present a higher value for the new weighting process than for the metrics average, according to users’ evaluation.
We have presented a **new model for usability evaluation** based on a **formative evaluation** composed by the application of a **set of complexity metrics**:

- **It reduces the time and money costs** by detecting the usability problems in an early stage of the process.
- **It can be applied by non-usability experts**.
- **It makes use of a new weighting process** based on the correlation between metrics results and users’ opinion.

**Three lines to explore:**

- **To improve the usability level** of the interface by optimizing the metrics results.
- **To confirm** the goodness of obtained results with the **weighting process** by checking them with real users’ opinions.
- **To determine** if the usability level noticed by the users depends on the specific users: “**personal usability level**”. 
5. Conclusions and Future Work

• Thank you

Any question?