

Methodology for the Scented Widgets Systematic Review

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1 INTRODUCTION

At first, one of the authors initiated a preliminary search on Google Scholar to determine the vocabulary related to scented widgets and better define a search query. In this process we found 16 relevant papers. The search performed in google scholar was:

1. *user input visualization* - (first 100 results);

2. *dynamic query filters* - (first 100 results);
3. *scented widgets* - (first 50 results);
4. *visualization sliders* - (first 50 results);
5. *user interface controls* - (first 50 results);
6. *scent encodings* - (first 50 results).

The resulting papers were retained based on a visual inspection of their figures mainly.

In addition to the existing set of papers, we used forward and backward snowballing [6] from Willett *et al.*'s paper on scented widgets [5] in Google Scholar to have an initial set of papers. This search identified 17 additional papers..

The methodology used next for our systematic review follows the PRISMA 2020 guidelines [3, 4, 2].

2 RATIONALE

This systematic review's goal is to fulfill two goals in mind:

- Build on the work of Willet *et al.* [5] with publications from 2007 till 2023. What's new?
- Categorize visualizations for scented widgets based on recent work and provide an interactive and living web-survey.

3 ELIGIBILITY CRITERIA

For being retained, a paper had to fulfill the following criteria:

1. The paper figures should contain widgets (user controls) that are enriched with additional information (typically feedforward information).
2. The user should be able to interact with the widgets => different than a glyph or simple visual cue.
3. The scent should be in the proximity of the widget (see also guidelines from scented widgets paper).
4. Should not be primarily a interaction technique with some chart (e.g. lasso, zoom etc.).
5. There should be at least one additional information which is enriching the widget, e.g. distribution on top of a slider.
 - a) Classical solutions presented in Scented Widgets original paper will be repeated but to a limited extent.
6. Or it needs to be a very specific control in very unusual contexts - original solutions (example slider inside the text, where clicking).
7. Or it needs to be a totally new widget design for a classical action/widget (even if it doesn't have scents).
8. Not an alternative visualization to an existing visualization: e.g. hierarchical visualizations can be represented in so many forms.

4 INFORMATION SOURCES

We considered major visualization and human-computer interaction journals and conferences, and relevant scientific databases indexing their papers.

4.1 JOURNALS

Selected journals are:

- IEEE Transactions on Visualization and Computer Graphics (TVCG)
- Computers & Graphics (C&G)
- Computer Graphics Forum (CGF)
- IEEE Computer Graphics & Applications (CG&A)
- Information Visualization (IV)
- Visual Informatics (VisInf)
- Transactions on Computer-Human Interaction (TOCHI)
- The Visual Computer
- Journal of Visualization

4.2 CONFERENCES

Selected conferences are:

- IEEE Visual Analytics in Science and Technology (VAST)
- IEEE Visualization Conference (VIS) short papers track
- Eurographics Visualization (EuroVis)
- IEEE Pacific Visualization (PacificVis)
- ACM Conference on Human Factors in Computing Systems (CHI)
- ACM Intelligent User Interfaces (IUI)
- ACM Symposium on User Interface Software and Technology (UIST)
- International Conference on Advanced Visual Interfaces (AVI)
- Nordic Conference on Human-Computer Interaction (NORDCHI)
- ACM Conference on User Modeling, Adaptation and Personalization (UMAP)

4.3 DIGITAL LIBRARIES

The search for these journals and conferences were performed in the following digital libraries:

- IEEE XPLORE (<https://ieeexplore.ieee.org/search/advanced>)
 - Conferences: VAST, VIS, PacificVis
 - Journals: TVCG, CG&A
- ACM digital library (<https://dl.acm.org/search/advanced>)
 - Conferences: CHI, IUI, UIST, AVI, NORDCHI, UMAP
 - Journals: TOCHI
- Wiley online library (<https://onlinelibrary.wiley.com/search/advanced>)
 - Conferences: EuroVis (Full papers and STAR Reports)

- Journals: CGF
- Springer (<https://link.springer.com/advanced-search>)
 - Journals: Journal of Visualization, The Visual Computer
- ScienceDirect (<https://www.sciencedirect.com/search>)
 - Journals: VisInf, C&G
- Sage journals: (<https://journals.sagepub.com/>)
 - Journals: IV

5 SEARCH STRATEGIES

- IEEE XPLORE
 - Filters
 - * Year range: 1981 – 2022 (not set, proposed option)
 - Query (Wildcards limited to 8):
 - * (*"Full Text & Metadata":widget OR "Full Text & Metadata":slider OR "Full Text & Metadata":filter OR "Full Text & Metadata":user control OR "Full Text & Metadata":user input* OR "Full Text & Metadata":dynamic quer**) AND (*"Full Text & Metadata":scented OR "Full Text & Metadata":data scent* OR "Full Text & Metadata":information scent* OR "Full Text & Metadata":embedded visualization* OR "Full Text & Metadata":data preview* OR "Full Text & Metadata":feedforward information OR "Full Text & Metadata":visual cue* OR "Full Text & Metadata":navigation cue**) AND (*"Publication Title": Visualization Conference OR "Publication Title": Visual Analytics in Science and Technology OR "Publication Title": Computer Graphics*)
 - Results:
 - * Number of records : 612
 - * Extraction method: Extracted using the export functionality in IEEE Xplore user interface



- Search performed on date: September 1, 2022
- ACM digital library
 - Filters
 - * Year range: 1965 – 2022 (not set, proposed option)
 - * Content type:

- Research article
- Short papers
- Posters
- Abstracts
- Surveys
- Extended abstracts

– Query:

* (*AllField:(widget*) OR AllField:(slider*) OR AllField:(filter*) OR AllField:("user control*") OR AllField:("user input*") OR AllField:("dynamic quer*")*) AND (*AllField:(scented) OR AllField:("data scent*") OR AllField:("information scent*") OR AllField:("embedded visualization*") OR AllField:("data preview*") OR AllField:("feedforward information") OR AllField:("visual cue*") OR AllField:("navigation cue*")*)

– Results:

- * Number of records : 790
- * Extraction method: page by page from the user interface



Export Citations

– Search performed on date: August 30, 2022

• Wiley online library

– Filters

- * Year range: 1986 – 2022 (not set, proposed option)
- * Content type:
 - Subject: Computer Science

– Query:

* (*widget* OR slider* OR filter* OR "user control*" OR "user input*" OR "dynamic quer*"*) AND (*scented OR "data scent*" OR "information scent*" OR "embedded visualization*" OR "data preview*" OR "feedforward information" OR "visual cue*" OR "navigation cue*"*)

– Results:

- * Number of records : 211
- * Extraction method:
 - Using the Wiley Federated search API. API documentation below:

<https://onlinelibrary.wiley.com/pb-assets/Lib%20Marketing/Discovery/SRU%20for%20Wiley%20online%20Library%20-%20Literatum.pdf>

- Using <https://insomnia.rest/> as tool for manually repeated queries with startRecord variable changed from 0,21,41,...201. Below the formatted query. Directly pasting below query in Insomnia should reproduce an example of output (with validate certificates options off):

```
curl -k --request GET --url "https://onlinelibrary.wiley.com/action/sru?query=cql.anywhere%3D((widget%20OR%20slider%20OR%20filter%20OR%20%22user%20control%22%20OR%20%22user%20input%22%20OR%20%22dynamic%20quer%22)%20AND%20(scented%20OR%20%22data%20scent%22%20OR%20%22information%20scent%22%20OR%20%22embedded%20visualization%22%20OR%20%22data%20preview%22%20OR%20%22feedforward%20information%22%20OR%20%22visual%20cue%22%20OR%20%22navigation%20cue%22)%20AND%20(dc.subject%3D%22Computer%20Science%22))&startRecord=201"
```

– Search performed on date: August 30, 2022

- Springer

- Filters

- * Year range: 1988 – 2022 (not set, proposed option)

- * Content type:

- Conference paper

- Article

- * Discipline:

- Computer Science

- * Subdiscipline:

- User Interfaces and Human Computer Interaction

- Query:

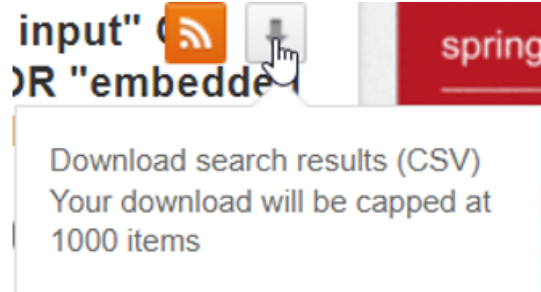
- * *(widget* OR slider* OR filter* OR "user control*" OR "user input*" OR "dynamic quer*") AND (scented OR "data scent*" OR "information scent*" OR "embedded visualization*" OR "data preview*" OR "feedforward information" OR "visual cue*" OR "navigation cue*")*

– Results:

* Number of records : 861

* Extraction method:

- Using Springer user interface download option



- The download resulted in most metadata (title, authors, doi etc.) but not abstracts.
- The abstracts were extracted based on the doi information available from the previous step. This data was used with the Crossref API using curl. Below an example query (can be tested using insomnia as well). Such a query was looped for all DOI numbers (using enclosed python script from supplemental material):

```
curl -Lk
--request GET
--url http://dx.crossref.org/10.1007/s11257-019-09247-2
```

– Search performed on date: August 31, 2022

• ScienceDirect

– Filters

* Subject area:

- Computer Science

– Query:

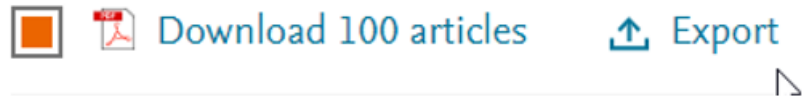
* (*widget OR slider OR filter OR "user control*" OR "user input*" OR "dynamic quer*"*) AND (*scented OR "data scent*" OR "information scent*" OR "embedded visualization*" OR "data preview*" OR "feedforward information" OR "visual cue*" OR "navigation cue*"*)

– Results:

* Number of records : 2042

* Extraction method:

- By going manually through the 21 pages of results (100 results/page) and downloading the results using the download option of the ScienceDirect user interface



– Search performed on date: September 1, 2022

- Sage journals

- Filters

- * Subject area:

- Computer Science

- Query:

- * *(widget OR slider OR filter OR "user control*" OR "user input*" OR "dynamic quer*") AND (scented OR "data scent*" OR "information scent*" OR "embedded visualization*" OR "data preview*" OR "feedforward information" OR "visual cue*" OR "navigation cue*")*

- Results:

- * Number of records : 1429

- * Extraction method:

- By going manually through the 15 pages of results (100 results/page) and downloading the results using the download option of the user interface

[Download selected citations](#)

Select all

– Search performed on date: September 1, 2022

6 SELECTION PROCESS

1. Paper deduplication based on DOI.
2. Automatic paper annotation using a custom-built annotator. Papers were tagged with the search query keywords appearing in either the title, the abstract or the author-supplied keywords of the paper. As the search query had two parts, one in relation to the concept of widget and its variations and the concept of scent and its variations, at stage we retained papers that matched at least one of the following phrases, which reduced the corpus to 392 papers:

"slider", "sliders",
"widget", "widgets",
"scented widget", "scented widgets",
"scented slider", "scented sliders",
"scented filter", "scented filters",
"scented input", "scented inputs",
"scented control", "scented controls",
"dynamic query", "dynamic queries",
"user input", "user inputs",
"user control", "user controls",
"scented",
"data scent", "data scents",
"data preview", "data previews",
"information scent", "information scents",
"embedded visualization", "embedded visualizations",
"feedforward information",
"visual cue", "visual cues",
"navigation cue", "navigation cues".

3. A manual screening by two coders of the 392 papers, completed by peer debriefing [1] with a third coder to resolve disagreements about 79 papers, finally retaining 23 papers. We added then the initial 16 papers (see page 2) to reach 39 papers.
4. A backward snowballing from a selection of papers, adding 37 papers (the initial 17 + an extra 20) to the corpus, for a total of 76 papers.

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