A review and extension of the Visual Information Seeking Mantra (VISM)

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***Abstract*—The primary Visual Information Seeking Mantra (VISM) [1] has been extended overcoming known weaknesses [2], [3] regarding complex information handling. An improved framework, the so called Visual Information Seeking Mantra 2.0 (VISM 2.0), is derived supporting formerly missing tasks and improving existing ones. The proposed framework is furthermore embedded in a User-Centered Development (UCD) process in order to support a (front-end) developer throughout the whole development process of an information system.**

I. Introduction

It was back in 1996 when Shneiderman [1] published his path-breaking VISM. This framework proposes to follow the principle to first provide an overview of the data to provide (*overview first*), and secondly to zoom and filter the visualized data (*zoom and filter*), before a user can finally look at details if desired (*details-on-demand*). Shneiderman provided and defined a new approach on how to visually present data in order to support a user in finding the relevant information at a time when the Word Wide Web was just beginning to emerge.

If we compare the highly connected world of today that links together a bundle of heterogeneous devices like smartphones, tablet computers or notebooks to provide us with a constantly increasing volume of information, it becomes evident that today's world has not much in common with the world of 1996. Nevertheless the VISM seems to be a constant basis in this always changing digital environment as it is still popular and widely accepted in the area of Human-Computer Interaction (HCI) [4], [5], [6]. If we take a closer look at all the different input devices like multi-touch surfaces, perceptual interfaces or voice recognition that have become accepted and successful since 1996, it is obvious that the digital world is no longer dominated by the mouse and the keyboard. Input devices and Graphical User Interfaces (GUI) are tightly coupled. But they need to form a symbiosis to guarantee improved usability. It is therefore arguable whether the VISM can still be fully applied nowadays or not.

To investigate this topic, this paper is organized as follows. First, there is an thorough *Literature Review* of the existing VISM. Secondly, based on the criticism found in the literature the new VISM 2.0 is developed in chapter *Visual Information Seeking Mantra 2.0*. Finally, the *Conclusion* provides a summary of the findings and an outlook to possible future research.

II. Literature Review

The VISM proposed in 1996 is a coarse-grained guideline of how to present data to the user in the most effective way with an information visualization software [1]. VISM suggests to offer data in a strict order: *Overview first, zoom and filter, then details-on-demand*, as given in Figure 1. However, there are some tasks like *Relate*, *History* and *Extract*, which are not directly linked to this process. The mantra itself is based on personal and long-standing experience that could be gained in different projects [1]. Although VISM lacks a rigorous scientific validation it has become a quasi standard in the field of data intensive visualization applications [2], [7], [3].

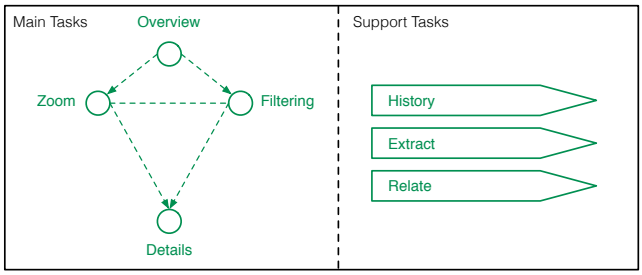

Fig. 1. Visual Information Seeking Mantra

In addition to the VISM there is also the task-by-data-type taxonomy (TTT) addressed in *The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations* [1]. This paper reveals the problem of formulating non trivial Boolean search queries and elaborates how they can be improved with so called *Advanced Filtering* methods. As an example of an advanced filtering method TTT proposes a range of different data type categories like 1-, 2- and 3-dimensional as well as temporal, multidimensional, tree or network ones. Depending on the data type, the user has varying needs that a graphical user interface has to satisfy to be useful. However, TTT is only one of many data taxonomies and could never reach the popularity of the VISM [2].

A thorough analysis of VISM is given in *Beyond Guidelines: What Can We Learn from the Visual Information Seeking Mantra?* [2]. First this paper discusses the problem of the missing validation of VISM. Nevertheless VISM has been and still is an inspiration and a guideline for many practitioners, especially front-end designers. Furthermore, the paper defines and explains each of the tasks of VISM in a more detailed way. It especially points out the importance of a clear distinction between zooming-in and zooming-out as these are two different cognitive tasks. Another relevant issue revealed is that the VISM does not provide any information regarding when to use which visualization technique (task) in order to provide the highest benefit for the user. It is therefore not clear whether any of the User Interface (UI) elements are conflicting with each other, or whether all tasks are useful for all of the data types. Finally the paper concludes that VISM is often used as a starting point as well as a guiding principle for information visualization design. However, VISM does not provide any design-patterns of how to support different tasks of UI elements. Consequently, a new methodology called *holistic design methodology* has been proposed:

- Take into account the useful techniques that guidelines and patterns suggest
- Generate a measurable validity based on a user-centered development framework
- Provide step-by-step approach, useful for both novices and experts

In *The Surest Path to Visual Discovery* an application of VISM has been shown by means of the software *TimeSearcher 2* [7]. The paper focuses on the four main tasks *Overview First*, *Zoom and Filter* and *Details-on-Demand* only. As a result the paper reveals that data analysis is not only as straightforward as it is meant to be within the process of VISM, but rather dynamic. The paper furthermore underlines the importance of smoothly switching between different tasks as data analysis comprises bouncing back and forth. In the best case the UI becomes a natural extension of the human body, so that users forget that they are using a computer. As a result, users can focus fully on their actual task they want to conduct [7].

In *When the visual information-seeking mantra fails* are several drawbacks of VISM are revealed [3]. Hence the main disadvantage is the fact that many users already have in mind a specific task, before they start using a software. Starting with an overview hinders and slows down the data analysis process. As a result, the *Overview First* is only suitable for beginners of an application, who need stronger guidance. On the other hand, an application should offer cognitive support for frequent and expert users (dynamic usage). This criticism is related to the *holistic design methodology* [2], where only one UI element should be designed, *useful for both novices and experts*.

A broad analysis of the topic of information seeking systems, without focusing only on VISM, is provided in *Lessons Learned from the design and evaluation of visual information-seeking systems*[8]. Based on experience in the field of Human-Computer-Interaction (HCI), this paper provides four general principles of how to improve visual information seeking applications. The first principle states that an application should *support various ways of formulating an information need*. Formulating an information need is one of the most important tasks in a visual information seeking system. However, it is also one of the most error-prone activities as users differ in their needs and ways how to use an application. Regarding information search, it is relevant to offer a broad variety of how to formulate an information need and how to satisfy it, e.g. known-item search vs. open-ended tasks. Proposed techniques that can support and improve the search are *query preview*, *query expansion* and *query refinement*. The other three principles are *integrate analytical and browsing oriented ways of exploration* (possibility of seamless switching between different ways of behavior), *provide views for different dimensions of an information space* (smooth integration of so called multidimensional information spaces), and *make search a pleasurable experience* (integration of "soft factors" to increase user experience).

III. Visual Information Seeking Mantra 2.0

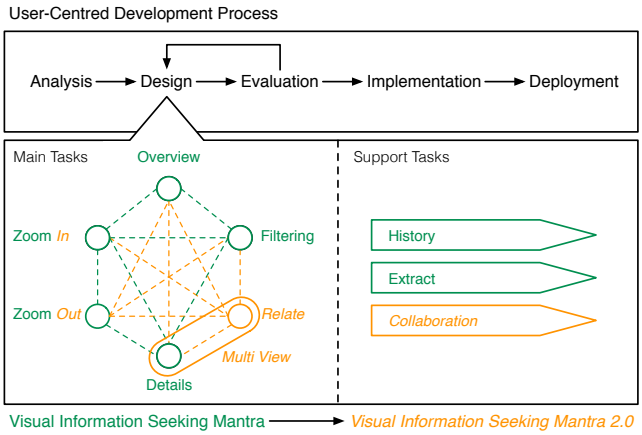

Fig. 2. Visual Information Seeking Mantra 2.0 based on a UCD process

The VISM 2.0, see Figure 2, is based on the original VISM [1] considering the necessary improvements as proposed in the literature [2], [3]. This mantra is divided into two parts. The upper represents the User-Centered Development (UCD) process as proposed in the Holistic Design Methodology [2] whereas the lower part represents the actual VISM 2.0. The UCD process is also known under the term human-centered design process and is defined by ISO 13407 as: "Human-centered design is an approach to interactive system development that focuses specifically on making systems usable. It is a multi-disciplinary activity"[9]. The iterative UCD process consists of five phases where the first three, *Analysis*, *Design* and *Evaluation*, are the important ones for the VISM 2.0.

Analysis: "Identify and understand the users' goals and tasks, the strategies they use to perform the tasks, the tools they currently use, any problems they experience, and the changes they would like to see in their tasks and tools" [10]. Typical methods are [9]:

- User/Audience analysis
- Task/Purpose analysis
- Information architecture analysis
- Workflow analysis

Design: "Using the results from task and competitive analyses, create alternative solutions, solicit feedback through design walk-through sessions with users, and choose a solution based on user input" [10]. Typical methods are [9]:

- Design concepts
- Storyboards, wireframes
- Paper prototypes
- Functional online prototypes

Evaluation: "Periodically solicit user feedback on the evolving design and iterate the design based on the analysis of users' experiences with it" [10]. Typical methods are [9]:

- Design walkthroughs ("cognitive walkthroughs")
- Heuristic evaluation
- Guidelines reviews
- Usability testing

Although the other two phases *Implementation* and *Deployment* are also part of the UCD process, their influence on the final usability is rather small as the user interface (UI) must be defined before the *Implementation* starts. Nevertheless, a well-designed UI concept with respect to all usability guidelines does only work properly if the *Implementation* and *Deployment* are correctly worked out. Thus, the UCD process not only consists of the first three stages, but of five.

The proposed VISM 2.0 can be regarded as a framework. Hence, it should be used during the *Design* phase as it builds and provides a skeletal structure upon which a user interface can be built on. VISM 2.0 is separated into two parts, see Figure 2. On the left hand side all the *Main Tasks* are collected and connected with each other. We regard *Main Tasks* as tasks, which are typical for the use of a certain application. For example for an Enterprise Resource Planning (ERP) system, there could be the task "Print All Debtors". This task could first show all debtors on a list (*Overview*) from which a user can then filter a certain part (*Filtering*) to finally see all information about a subset of all debtors (*Details*) that the user would like to print. Additionally, there are *Support Tasks* on the right hand side. These tasks are more generic than the *Main Tasks* and therefore reusable or valid for a wide range of applications.

One relevant difference of the *Main Tasks* with respect to the original VISM is that we distinguish between the two tasks *Zoom In* and *Zoom Out* instead of having a single task *Zooming* [2]. Another discrepancy is the dissolving of the strict order between each single task. Now, a user is allowed to switch smoothly between the different tasks so that the users needs are best possibly covered. This finally allows to design dynamic UIs that fit novice users as well as power users [3], [2], [7]. Another change is the implementation of so called *Multi Views*. A *Multi View* is a particular UI consisting of more than one task at the same time as drawn in Figure 2 by aligning *Relate* and *Details*. The tasks do not necessarily need to be different, so that also two or more *Overview* tasks can be shown simultaneously. Thanks to this combination of different tasks into one display, it becomes possible to integrate different data sources at the same time [8].

With respect to the *Support Tasks* on the right hand side of the VISM 2.0, it becomes evident that there is now a *Collaboration* task advocated. This new task should give users direct access to communication tools, so that no further third-party applications are necessary as it is the case in many solutions nowadays [8]. The support of *Collaboration* becomes especially important as the information search and analysis becomes more and more a collaborative task due to the increasing data volume. Finally, there are the known tasks *History* (e.g. *undo*/*redo*) and *Extract* (e.g. *save* and *open file*) from the original VISM [1].

We think that the new VISM 2.0 can resolve many of the criticism regarding the original VISM [1] as it offers a dynamic step-by-step framework that supports multiple data sources as well as collaboration. Nevertheless, there are also some unsolved points especially with respect to the *holistic design methodology*. One of them is the still missing *Measurable Validity*, which should be considered in future research. Secondly, VISM 2.0 does not provide any design patterns on how to support the different tasks. It will be necessary to analyze different UI elements (e.g. checklist, drop-down menu, button, tree, etc.) to find out whether they are especially suitable to a certain task or not.

IV. Conclusions and Outlook

The research work presented in this paper investigates the extension of the VISM [1]. A literature review shows several criticized aspects and provides some improvements with respect to the VISM. Based on these improvements, we propose an adapted mantra, the so called VISM 2.0. This newly developed framework can be seen as work-in-progess and should form the foundation for further discussion, investigations and finally improvements with respect to information seeking applications. Based on the already found improvements, we see potential room for further improvements especially regarding the validity of VISM respectively VISM 2.0.

A. Findings

Much research has been done to improve and adapt the primary VISM [2], [3], [7], [8]. Many open questions with respect to the primary VISM can be answered leading to the new VISM 2.0. This new framework does now distinguish between *Zooming In* and *Zooming Out* [2]. Furthermore, the new mantra now offers a dynamic framework from which user interfaces can be built for novices as well as for advanced users. Additionally, the *Collaboration* task suggests to implement communication possibilities directly inside of the information seeking application.

B. Conclusions

VISM 2.0 reuses most parts of its famous predecessor. It provides, together with the UCD process, a lightweight framework for developers that allows them to improve the usability of applications in general. Due to its generic composition it does not impede the developers in their creativity, which should especially increase its acceptance among HCI experts and software developers.

C. Outlook and Future Work

This paper is based on research work focusing on literature research. We derive many aspects for discussing, analyzing and combining them in order to extend the original VISM. In the next step, a profound validation of VISM 2.0 is necessary as it is not proven in detail yet how the new mantra can help during the development of an information intensive application especially with respect to its usability. To validate VISM 2.0 a comparison of an application with and without the use of this framework could be performed in a field study. In addition VISM 2.0 does also not provide any design patterns yet as proposed in the *holistic design methodology* of [2]. Following this, future research could conduct an in-depth analysis of existing design patterns to match them with the different tasks as suggested by the new mantra.

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