LITERATURE REVIEW I

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Date : 02/28/2018

Primary Paper :

A Data Model and Task Space for Data of Interest (DOI) Eye-Tracking Analyses

@ARTICLE{7845707,
author={R. Jianu and S. S. Alam},
journal={IEEE Transactions on Visualization and Computer Graphics},
title={A Data Model and Task Space for Data of Interest (DOI) Eye-Tracking Analyses},
year={2018},
volume={24},
number={3},
pages={1232-1245},
keywords={Context;Data models;Data visualization;Semantics;Taxonomy;Three-dimensional displays;Visualization;Eye-tracking;taxonomies;visual analysis models},
doi={10.1109/TVCG.2017.2665498},
ISSN={1077-2626},
month={March},}

Secondary Paper :

Low-level components of analytic activity in information visualization

@INPROCEEDINGS{1532136,
author={R. Amar and J. Eagan and J. Stasko},
booktitle={IEEE Symposium on Information Visualization, 2005. INFOVIS 2005.},
title={Low-level components of analytic activity in information visualization},
year={2005},
volume={},
number={},
pages={111-117},
keywords={data analysis;data visualisation;user interfaces;analytic question;data set analysis;information visualization system;information visualization tool;low level analysis task;system level taxonomy;user analytic activity;visualization task;Algorithm design and analysis;Chromium;Computer applications;Data analysis;Data visualization;Educational institutions;Information analysis;Motion pictures;Performance analysis;Taxonomy},
doi={10.1109/INFVIS.2005.1532136},
ISSN={1522-404X},
month={Oct},}

The primary paper here, is discussing eye-tracking which the authors consider as an yet to be explored field as most of the studies done in this area are based on simple activities. Eye-tracking is widely used in fields such as psychology, neuroscience, human-computer interaction, and data visualization to analyze how people perceive and think with visual stimulus. The Data of Interest (DOI), which is based on what the users look at instead of where they look at is an extension of Area of Interest (AOI). The data in DOI approach is captured in an interactive environment as it does not change with alteration in the visual representation. As the attributes of this data can be used in data-driven analysis, it's more useful in learning of the user's data exploration pattern.

The paper takes reference from the secondary paper which discusses the user's questions and response to information visualization systems. It says that "analytic primacy", which focusses on more closely mapping visualization systems to user analytic goals instead of "representational primacy", a data-centric view of information visualization that relies on user ability to generate insight is more valuable in information visualization. It states that more importance should be given to user tasks and activities as they tend to work in cross-domain scenario. Previous systems have failed to achieve this, however, they were able to work well for certain domains. The analysis ranges wide from high level goals to low level inquiries.

The data for this paper was generated from about 200 sample questions from students about how they would analyze five particular data sets from different domains. Based on their responses, the authors have proposed a set of ten low-level analysis tasks that mainly evaluate people's activities while using information visualization tools for understanding data. The authors also discussed related work involving Data-Centric Approaches which uses statistics to extract potentially useful hypotheses from data and Task-based and System-based Taxonomic Approaches in which a matrix of representation techniques to create a mapping between techniques and problems is used.

For analysis,they used an affinity diagramming approach, grouping similar questions and iteratively filtering the groups according to what they assumed to be the core knowledge goal of the questions in each group. The ten tasks from the affinity diagramming analysis were: • Retrieve Value • Filter • Compute Derived Value • Find Extremum • Sort • Determine Range • Characterize Distribution • Find Anomalies • Cluster • Correlate.

These tasks are thought to be the ground for discussion and not purely meant for analysis purpose. The authors believe that as the data was generated from the questions from students, the domain experts may give a different angle to the data if tested on them. They might come up with broader and detailed questions and responses as opposed to the generic data collected from students. The user's response to the data is used for determining the user's eye tracking in the primary pattern.

The primary paper states that the Fovea, a high acuity region in the center of the eye, allows us to perceive small portion of the view in minute detail. We stay at the points of interest for short periods of time to extract details around them. The movements in the fovea are based on the cues which the user receives from peripheral view. These cues are guided by cognitive processes and is termed as the top-down approach. On the contrary, when the user is drawn to what it finds

interesting is the bottom-up approach. The authors used DOI methodology in three projects. They reported on the the instrumentation process, the data collected, and the research goals of these projects as a means of exemplifying the research processes that the DOI approach can serve to.

They based their methods on the extracting the data from different scenarios. Some of which included Tracking Data Consumption in Visualization Systems, Understanding Student Learning and exploring how Workers Detect and Assess Hazardous Situations on Construction Scenes. The data from these different setups helped them structure their DOI model. The DOI approach is to capture both visual and semantic data from eye-tracking experiments to support diverse research questions, such as about perception, cognition, or data exploration and search. DOIs also include visual attributes that describe how that data is represented on the screen. A DOI instrumentation will capture for each user fixation, the DOIs the user may have intended to view, potentially along with low-level attributes of the respective fixation. The paper also presents the data from three applications obtained to support this DOI model.

The authors also discussed the limitations of the DOI approach proposed in this paper. They feel that in most cases people keep staring blankly as their mind is immersed in some other thoughts. This might be misleading. When users are performing high level tasks, they might look over the details and concentrate on the broader picture. The authors also mention that the object which the user is fixated on may not be the entirely of his interest as he may be perceiving visual from the peripheral vision. As the model does not take this account, the results may not be that accurate. This makes the authors feel that while this approach may be useful for smaller view, it fails for broader screens due to high presence of noise. It also states that while DOIs can be regarded as a mere extension of AOIs, there are significant differences in DOI data properties and how it is collected, the research goals it can support, and the data questions it facilitates.