How Visualisation and Interaction Can Optimize the Cognitive Processes Towards Big Data

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INTRODUCTION

Visual analytics is the study of transformation of data to visual representations. The goal is to create these representations in such a way that their interpretation is driven by effective and efficient cognitive processes that enable an easy understanding of the data itself. Today, visualization and visual analytics is more than just a collection of plots, graphs, and computer-generated 3D renderings. There are many visualization techniques for every form of data, including, but not limited to, texts, documents and corpora, tree graphs and networks, image collections and videos, time series, tabular and multivariate data, geographical data, scalar vector, and tensor fields, isosurfaces, numerical, geometrical, statistical and other mathematical models, historical events and provenance records, dynamic data streams, algorithms, programs, and computational logs, and a wide range of domain-specific data in disciplines such as engineering, biology, medicine and many others.

Visualization is easily perceived as a means for presenting beautiful computer generated images and animations to impress an audience. However, significant evidence obtained through perceptual studies and user evaluation confirms that proper visualization has enabled researchers and decision makers to be more efficient in gaining insights from data and therefore efficiently improving their cognitive system. It facilitates the formulation of new hypotheses, assists in decision-making, enables effectual communication of ideas, and facilitates dissemination of knowledge.

To gain insight into these data, to make sense of these data, and to gain new scientific knowledge out of it, we must proceed to work on and aim to define efficient and user-friendly solutions.

The importance of having proper visualisation solutions to improve and optimize the memorizing processes is continuously increasing, e.g. to optimize time and effort in cognitive learning processes and in gaining insights from geo-spatial, behavioral, commercial, scientific data.

Useful data is generated with the advent of new hardware technologies and with sensors embedded everywhere. Examples are CCTV cameras, social media, and systems where machines and users generate contents in various forms, such as, videos, images, text and geospatial data. This data represents a valuable source to identify trends in all sectors. Leveraging social media data presents many challenges: social media data has a large volume; it is a multimodal set of data, it is often ambiguous in its content, and is highly context- and user-dependent.

Moreover, Human Computer Interaction (HCI) transformed the way end users are interacting with information. New interaction paradigms, such as voice recognition, gesture based interactions and multi-touch interaction now enable a deeper interactive experience in memorizing information and in optimizing search for information.

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Mobile platforms like smart phones and tablets have advanced significantly in the last 10 years. The incorporation of faster processors and mobile GPUs has greatly increased the impact and range of applications. The ubiquity of geo data and mapping applications for smart phones has familiarized a broad base of users with the navigation and interpretation of 2-D maps as well as 3-D maps that have been introduced on the major mobile platforms. This phenomenon is also increasing the familiarity of users with navigating in 3-D textured environments not only representing geographical spaces.

The following chapter describes the transformation of cognitive processes through different ways of interacting with data as well as it describes the importance that visualisation is gathering as a common taxonomy to optimize insights from disseminating and sharing data. Its structure is as follows:

1. The first part focuses on the Human Computer Interaction and Interactive Digital Media,
2. The second part focuses on Big Data and Interaction, and
3. The last part comprises of the description of the experiment and the authors conclusions.

The chapter is structured as follows:

1. A first part focuses on the Human Computer Interaction and Multi model user interfaces,
2. The second part on Interaction,
3. The last part comprises of the results from an experiment and the authors conclusions.

BACKGROUND: HUMAN COMPUTER INTERACTION AND MULTI-MODAL USER INTERFACES

To define HCI is not a simple task because of the applicative nature that this subject has and the continuous changes it is facing. Simply, we can assert that HCI tries to model and analyze the relation between man and computer where the element "computer" changed its nature drastically in the last decades following a very rapid dynamic of change[1]. Twenty-five years ago, few people would have anticipated the tremendous processing speed of contemporary computer systems. Even though major improvements have been made in many areas regarding HCI, important issues still remain (Szameitat et al., 2009). HCI studies very heterogeneous objects such as Personal Computers (PC), Personal Digital Assistant (PDA), Mobile Phones, but even simpler objects such as watches or electrical furniture as well as the technologies related to Internet or even more complex technological issues such as the control panel of a chemical plant, the plane cabin, and other. According to the Association for Computing Machinery (ACM) the definition of Human Computer Interaction is:

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.

There are other disciplinary points of view that would place the focus of HCI differently than computer science does - just as the definition of databases would be different from a computer science vs. a business perspective. HCI at large is an interdisciplinary area. It is emerging as a specialty concern within several disciplines, each with different emphases: computer science (application design and engineering of human interfaces), psychology (the application of theories of cognitive processes and the empirical analysis of user behavior), sociology and anthropology (interactions between technology, work, and organization), and industrial design (interactive products). From a computer science perspective, other disciplines serve as supporting disciplines, much as physics serves as a supporting discipline for civil engineering, or as mechanical engineering serves as