Framework for Knowledge Management Based in the Two-Stream Hypothesis

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Abstract. Information Systems are vital to all kind of business and research activities. In the last years the need for reliable information on time is becoming a differentiating factor for the results of the computer based activities. It is known that data makes possible information then knowledge and, eventually, will result some wisdom. However, much prior to the expected characteristics of such data and its usefulness, would be important to actually find it. On the Internet, search Engines are the key element to make relevant information available to a certain user. By learning about the human's search capabilities it should be possible to information systems, by enlarging the characteristics of source information towards human perceptive and cognitive functions. This paper describes the application of a research method to explore the development of a framework for knowledge management based on lessons learned from a neuroscience model known as the Two-Stream Hypothesis.

Keywords: Interoperability, Knowledge Management, Neurosciences.

1 Introduction

The evolution of the internet was supported with technological advancements in diverse industrial branches and supported by scientific research. The exponential growth of users along with all kinds of applications made the internet an unavoidable tool an asset for business research and social life. But if the internet aims to addresses the needs of humans, its architecture reflects only a technological support for communication and storage of knowledge information. In many cases it works like a business or a social network, the fact is that it doesn't mimic most of the major human characteristics, the ability to sense and feel emotions. It is legitimate to raise some questions; why the internet is oriented towards text and image ignoring the overall human sensorial perception of the world? Why emotions are not part of the foundations of information representation on the internet? And finally would there be a benefit for addressing those questions in a human oriented approach?

This paper is structured to follow the classical research method and draws a path towards the establishment of the foundations of a framework that uses sensation and emotions to improve knowledge management capabilities. In section 2 there is a

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presentation highlighting the technical evolution and its impact on value creation of such a proposed approach. Then in the section 3 the research method is followed, describing the research question and the observation that leads to the establishment of the research hypothesis. In section 4, the two-stream brain model is briefly described in order to follows the technological aspects that lead to the establishment of the proposed framework. Finally chapter 5 resumes the conclusions and future work.

This paper proposes the guidelines for the present work that consists on the establishment of a framework that supports sensorial and emotional information to improve information systems in the direction of the brain´s activity.

2 Technological Innovation and Contribution to Value Creation

When looking to the evolution of modern societies, especially in the last decade, the access to the needed information at the right time has assumed a vital role in citizens' daily life. The power of information is such that almost all decisions made in different sectors like science, technology, economics, and business development will be based on information that has been generated electronically. Information has become a key asset of the organization for its progress [1]. In order to provide that needed key information to organizations and citizens, knowledge management frameworks where established to supply that permanent hunger for information. By so many remarkable specificities, internet has become the most popular source of information [2] and it means that improvements in information management can have an interesting impact if we reshape information handling over the internet. Internet is used for many proposes from gaming to communication and this days so much on social networking and many other applications. But as for subjects like data handling, information deliverance or knowledge production we need to deal with files, symbols, webpages, in a word, objects. And thus we selected those diverse objects as target for our research.

The proposed improvement on object representation will create value by different ways. At first we notice new business opportunities by the fact that goods can be found by innovative methods. The importance of search engines for finding relevant information on the World Wide Web is Indisputable [3].With the current approach to internet as an information system, the probability of a product to be found depends mainly on the performance of a search engine and its index classification. Unless a product is referenced by a portal, the indexing of information is until now the most relevant factor that differentiates being found or stay forgotten on a long list of search results. A better characterization of source objects will allow more accurate searches and thus reducing misleading queries for the information we seek. This better characterization relies on the annotation added to the objects and can encompass sensorial information and emotions. As an example, an image of a kid running with the dog at the beach can include information about the barking of the dog, the sound of waves, the smell of the see, and emotions like happiness and excitement. As a result of the proposed framework, people should be able to reach information without the need to loose endless time in crawling over never-ending items just by the fact that they have a given keyword even completely out of the required context.

3 Followed Research Method

The proposed research work will follow a traditional research method with a research question over a background observation with a hypothesis that will be tested over a design experiment, leading to results to be analysed and published on its major findings. The proposed approach as diverse aspects on neuropsychology, neurophysiology and knowledge management applied to data handling, ontology creation and semantic mediation. Thus the research path is focused on improving information systems taking examples from existing neuroscience models as digging into neuroscience research is out of scope. As this research is on early stages a special focused was made on the Two-Stream Hypothesis [4] that seems to be one of the most interesting promising of such examples for knowledge management.

3.1 Research Question

The research question defines the area of the interest for the authors and the problem they want to address. The selected question; How to improve information systems based on lessons learned from neuropsychology and neurophysiology? Would the two-stream model of the brain represent interesting added value to knowledge management?

It is required that information systems have a representation of the world most like the way humans do. For that is necessary to have analogous kind of sensorial perception and emotional contextualization. To pursue such an approach a scientific challenges needs to be addressed; how to build a framework that handles knowledge based on sensorial and emotional information.

3.2 Background Observation

Information systems are mostly based on text information. As support to written data there are pictures and sometimes sound used to make multimedia contents. The brain has other approaches to store, and later, to seek for information.

Many brain models have been constructed based on experiments and observation. From hundreds of years most of the great classical philosophers like Plato, Aristotle, Spinoza, Descartes, Hobbes and Hume, had recognizable theories of emotion [5] tried to develop cognitive models and understand how the mind works. The authors want to apply those lessons learned to knowledge management. By observing the brains behaviour, human perception and learning capabilities we question if the information systems can be shaped with benefit to comply with some neurological models and if that results in more efficient knowledge management.

In order to better explain what is proposed by sensorial and emotional data, the next paragraphs will walk along the different senses and emotional data, describing the current status and what is considered for the proposed framework.

Vision is by large advantage the leading protagonist in every internet aspect. It all starts with search either by text or images. The latest estimations put a number of more than 3 billion photos on Flickr, a similar number of video clips on YouTube and an even larger number for images in the Google Image Search database [6].

Earing is the second sense with privileges on the internet, adding to the above mentioned resources with sound, it is important to mention the talks, presentations and even game soundtracks that are all examples of the use of sound.

Touch could be seen as the sense with a paradox. This is because input is mainly supported by touch on the keyboard or the mouse and these days with touch screens and multi-touch capabilities. However touch is a support tool for manipulation, the systems care for touch only in what it reveals about the user's intention.

Getting concrete to business application, furniture and clothing industry in general are examples of relevance for surface properties. Museums could propose to online visitors a new range of sensorial experience on sculptures and other artefacts.

Olfactory experience has been ignored at current information systems. In fact, when talking about technological devices for smell detection it will probably mean some smoke detection devices. In a first approach, the ontological incorporation of olfactory experience would allow captions about properties of a product like a perfume's description or descriptions along the visualisation of a movie.

Taste is probably the poor parent of the five senses as it is not known any effort to associate taste with sensor devices. Partially this could be due to its close dependence from smell which is also poorly developed in IT devices.

Emotions

Every business addresses specific or wide costumer needs. Giving special attention to the value chain that ends on a person, a client, a costumer, a buyer, whatever we call him, prior to whether he buys a good or stays undecided, the value of its emotion towards goods or business opportunities has unquestionable value.

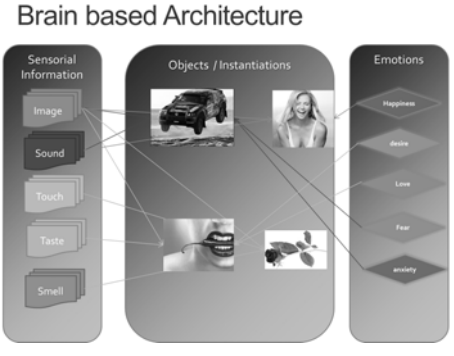

Fig. 1. Proposed Architectural Model

Emotions reflect the effect caused on humans by the sensorial experience of the world. An important part of our information-gathering behavior has always been to find out what other people think [7], thoughts and our perception of the world result in an emotional response that can be consciously assimilated and can simultaneously produce a physiological response. In affective computing, we can separately examine functions that are not so easily separated in humans [8], nevertheless, the study of emotions in what concerns to its relevance for information systems depends on the establishment of a proper ontology. There is a lack of applications that take emotion related aspects into account. This situation is mainly due to the great amount of proposed theoretical models and the complexity of human emotions [9].

3.3 Hypothesis

If we adopt selected brain models in order to improve knowledge management in databases or in the internet, then the probability of finding the desired information

will be higher. Getting more concrete with the following construction; 1) A new conceptualization of knowledge representation can support sensorial and emotional information 2) Support for meta information can foster sensorial and emotional representation methods 3) Semantic mediation can be supported by enlarged information and thus improving knowledge extraction and search results. With this in mind we will extend the sensorial information to the five senses, or at least enable that potential, also associating emotions textually expressed or device captured. Our goal is to facilitate better knowledge management by enabling different types of information extraction based in sensorial and emotional tagging.

4 Methods and Associated Concepts: The Two-Streams Brain Model

First we will look to a brain model and take it as basis for the current work and then explore some technical concepts that will bridge from the brain model to the technological framework. The last century was profuse in knowledge of the brain, many new theories raised from the information collected by electroencephalography (EEG), Magnetic Resonance Imaging (MRI) and its Functional variety (fMRI). All those equipments generate physiological data either by image or electrical signals, which researchers can analyse and theorise. However the impressive amount of data acquired can be, in some perspective, deceiving as there is no general theory of the brain, or universal model, even knowing that all brains have the same basic components; the hindbrain, the limbic system, and the neocortex. Our work consists not to develop brain theories, but to pick selected knowledge in this field and try to apply to knowledge information systems. In this scope the two-stream hypothesis provides clues about how brain processes visual information. As mentioned before, on the internet everything is mostly visual. We receive images that are formed in the occipital region of the brain [10], then according to the two-stream theory, the dorsal stream goes from the occipital lobe to the temporal lobe and is known as the "what stream" and the Ventral Stream goes from the occipital lobe to the temporal lobe and is known as the "where stream"[11].

Two findings are relevant in this theory, first, the brain tries to identify what is in the visual field, mostly by comparing with memories, and then the brain tries to give spatial context by establishing a sense of location for the visual information. So the cognitive process starts with images at the visual cortex, then two streams follow a path thru other regions of the brain where the same process of analysis and comparison to existing records is extended to other recorded sensorial information, thus empowering the what and where context findings. And that is the area where, from our research strategy, technology meets the brain.

A number of tools will be used to organise the ontologies related to diverse sensorial and emotional information. Semantic annotation is the basis of the early framework but it should foresee the interoperability with other sources of information described lately in this paper. The harmonization of different sources of information can be mediated with existing ontological frameworks like those proposed by the Mentor methodology[12]. Once established a resulting ontology it can be generalized with Neon Methodology[13] or such similar approach that generalises and upscale the identified ontological solution. It will be the basis of the proposed framework for knowledge management.

4.1 Design Experiment and Proposed Framework

We want to prove that a framework inspired in the two-stream model has a great potential for handling information in innovative and fertile knowledge bases. The objective of the proposed framework is to retrieve sensorial and emotional information creating great potential towards human oriented knowledge bases. For that two paths are followed; The first by exploiting the retrieval and storage of information as it happens according to the two-stream hypothesis. This could be backed by semantically-based Web Map Mediation Services a core of semantic and ontological tools for mapping [14], mediation, annotation and what else found needed for pursuing the most consensual and interoperable solution as possible. The second will instantiate a knowledge base and harmonise it with existing information thus providing an ontological solution which includes sensorial and emotional information either by properly instantiate with retrieved knowledge or by semantic annotation of existing knowledge bases.

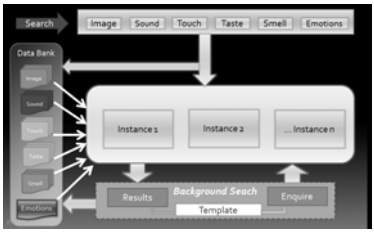

Fig. 2. Proposed early stage of the framework

The expected result in terms of contents is a new form of representing information allowing new acquisition opportunities and empowering existing knowledge. In terms of functionality, new services can be deployed, making use of sensorial and emotional information, providing more ubiquitously searching and finding of information.

Comparing to existing solutions, we propose a framework that supports; 1) a new data model including sensorial an emotional information along with 'traditional' data. 2) a new approach to search methods on the internet by allowing new specific fields with the proposed data model 3) a new ontology to facilitate standardization of the new data model. As a result we want to change the established paradigm of internet object location allowing new methods for knowledge management.

There are three sequential steps towards the establishment of the proposed framework. In all cases the development of an ontology for emotions and its instantiation will be present and research will be done using the above mentioned tools and services. The first step comprises the usage of the existing search engines to feed the new ontology with sensorial and emotional information. That means a different approach to search events with result in retrieving information for ontology instantiation. The second step consists on using the instantiations as a database for emotions and sensations thus improving the ontology usage with semantic sensorial and emotional annotation. Finally the

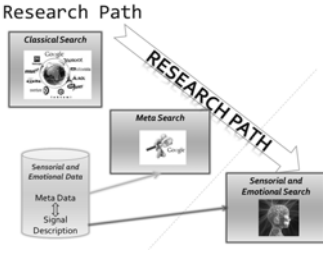

Fig. 3. Proposed research path

third step uses the infrastructure proposed by the precious steps but using sensorial representation and emotional information, this could be done with a new set of devices, some in development others to be deployed by new technological advances.

The first stage that is being developed consists in presenting a new data model that includes support for sensorial information starting with an annotation process that is referent to an ontology [15]. On a second stage, a template will be used as matrix for information retrieval and identification and can operate in background by searching for complementary information. At this stage the framework seeks information from the user and tries to associate as much sensorial and emotional information as possible in order to draw a path towards sensorial and emotional knowledge base. In parallel to the search and retrieve events, and as result of that operationalization of the framework, results a database of sensorial and emotional information collected and stored for future usage with other objects.

5 Concluding Remarks and Future Work

The aim of the proposed research path is to lead to an incorporation of sensorial and emotional information in knowledge bases but the proposed framework is yet on an early stage. Many devices are in early stages to provide a "flavour" of sensorial information. To name some, there are systems underway to spray water in some cinema scenes, gloves being developed for providing sensorial experience [16], devices to release basic scents following TV scenes and medical oriented devices can retrieve emotional information from patients, namely sweat and heartbeat. The proposed research work is in early stage but can integrate many of the so far existing technologies to provide new solutions for more efficient, more accurate and more complete knowledge bases.

The novelty of the present work can be identified by several innovations, the first is to consider senses and emotions as part of object representation and use it to increase the description of those objects. Thus there will be a major probability of finding what we are looking for with a benefit on search time and better knowledge handling.

We therefore conclude that lessons learned from the Two-Stream Hypothesis seem to be worth to import to data handling technics, thus enriching knowledge management processes. It is possible to start with a simpler framework to support semantic annotation of sensations and emotions with the expectation of progressively access stored records on sensations and emotions as it happens on our brain.

Future work for the proposed framework is vast and impact in many societal and business aspects. Just to name same, people with some sort of sensorial limitation, either blind or deaf, will have more chances to explore the internet as the sensorial experience will be expanded to other sensations. Also in business, enhanced product description will allow more chances to reach a wither range of potential customers.

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References

1. Khirwadkar, A.: Integration of ICT in Education: Pedagogical Issues. Assumption University: Education Review (1) (2007)
2. Reuters: Internet most popular information source, http://www.reuters.com/article/2009/06/17/us-media-internet-life-idUSTRE55G4XA20090617 (retrieved at October 2011)
3. Lewandowski, D.: The retrieval effectiveness of search engines on navigational queries. Aslib Proceedings 63(4), 354–363 (2011)
4. Mishkin, M., Ungerleider, L.G.: Contribution of striate inputs to the visuospatial functions of parieto-preoccipital cortex in monkeys. Behavioural Brain Research 6(1), 57–77 (1982)
5. Stanford Encyclopaedia of Philosophy: "Emotion", http://plato.stanford.edu/entries/emotion/ (retrieved from the web at October 2011)
6. Deng, J., Dong, W., Socher, R., Li. L.J., Li, K., Fei-Fei, L.: ImageNet: A large-scale hierarchical image database. In: IEEE Conference on Computer Vision and Pattern Recognition, CVPR, pp. 248–255 (2009)
7. Pang, B., Lee, L.: Opinion Mining and Sentiment Analysis. Trends Inf. Retr. 2(1-2), 1–135 (2008)
8. López, J.M., Gil, R., García, R., Cearreta, I., Garay, N.: Towards an Ontology for Describing Emotions. In: Lytras, M.D., Damiani, E., Tennyson, R.D. (eds.) WSKS 2008. LNCS (LNAI), vol. 5288, pp. 96–104. Springer, Heidelberg (2008)
9. Pinker, S.: How the Mind Works. Annals of the New York Academy of Sciences 882, 119–127 (1999)
10. Netter, F.H.: Atlas of Human Anatomy, Novartis (1998)
11. Ungerlider, L.G., Haxby, J.V.: 'What' and 'where' in the human brain. Current Opinion in Neurobiology 4(2), 157–165 (1994)
12. Sarraipa, J., Jardim-Gonvalves, R., Steiger-Garcao, A.: MENTOR: an enabler for interoperable intelligent systems. International Journal of General Systems 39(5), 557–573 (2010)
13. Neon Project, FP6 IST-2005-027595 (2010) (October 2011), http://www.neon-project.org/
14. Gahegan, M., Smart, W., Masoud-Ansari, S., Whitehead, B.: A semantic web map mediation service: interactive redesign and sharing of map legends. In: Wiegand, N., Berg-Cross, G., Varanka, D. (eds.) Proceedings of the 1st ACM SIGSPATIAL International Workshop on Spatial Semantics and Ontologies (SSO 2011). ACM, New York (2011)
15. Talantikite, H.N., Aissani, D., Boudjlida, N.: Semantic annotations for web services discovery and composition. Journal Computer Standards & Interfaces 31(6) (2009)
16. Shinohara, M.: Good Vibrations: Wearable Device that Vibrates Fingertip Could Improve One's Sense of Touch, Georgia Tech, http://gtresearchnews.gatech.edu/sensory-glove/ (retrieved at October 2011)