



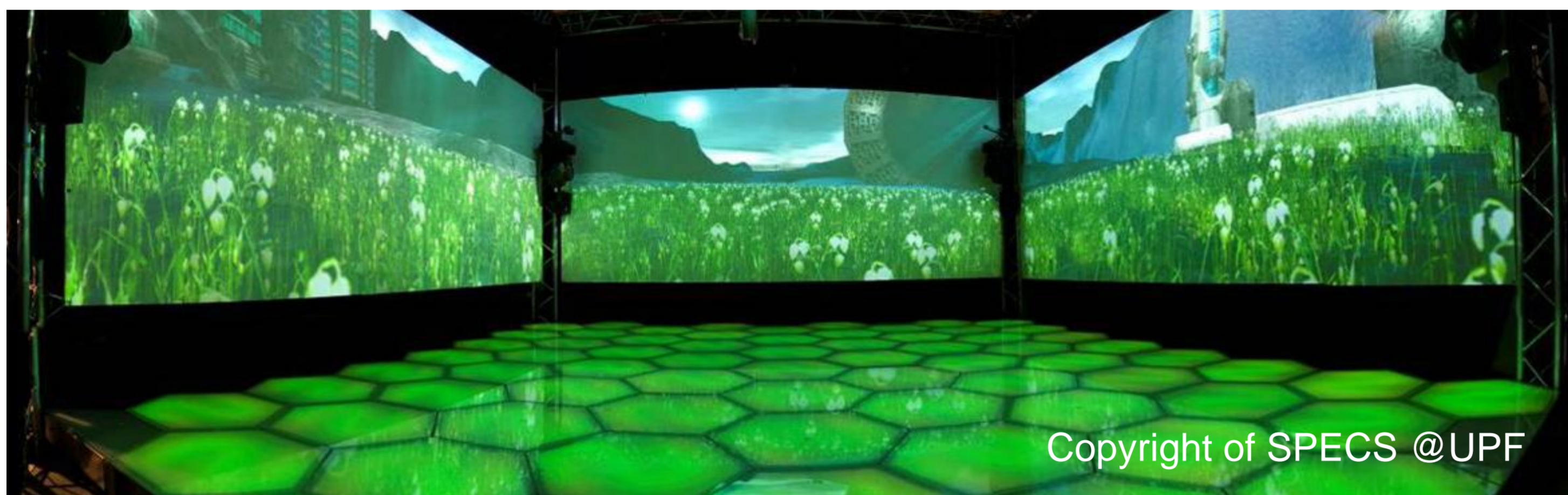
Unleashing the Power of the Subconscious

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THE DATA DELUGE

Graphical representation of quantitative data has a long history dating back to the earliest navigation maps [1]. With the advancement of statistics, the need for data visualisation techniques increased to enable easier communication of numbers and relationships between sets of numbers (e.g., trends and distributions). Recent advances in technology have rapidly increased our ability to capture, monitor and store data in all aspects of life. Data are now being generated faster than they can be processed. However, finding meaning in larger and more complex data sets is becoming more and more challenging. This phenomenon is often referred to as “the data deluge”. This data ‘bottleneck’ has led scientists to use statistical techniques to reduce multidimensional data to low dimensional constructs to find meaning in data. This simplification process raises the risk that scientists fail to discover subtle relationships in data within and across datasets. Attempts to capitalize on fully multidimensional datasets are further limited by the traditional representation tools available (e.g., 2D graphs).

FINDING MEANING IN DATA: CEEDS CONCEPT

The Collective Experience of Empathic Data Systems (CEEDs) project proposes a radical solution to these problems. CEEDs aims to develop a virtual reality based system that provides a tool to improve humans’ creative ability to experience interactively, process and understand large, complex data sets. In our everyday experience of the world, only a small subset of sensory input reaches conscious awareness, yet the remainder is still processed by the brain. Some authors have asserted that declarative understanding manifest in our explicit responses is merely a post-hoc rationalization [2], suggesting that implicit factors support our understanding of reality [3]. CEEDs contributes to addressing the question of how experts as well as novices can advance understanding of the world and the data extracted from it, by placing human experience at the centre of the solution.

CEEDs COMPONENTS

Implicit and Explicit Responses to guide users’ discovery within the datasets

In the CEEDs project, it is planned to develop interactive representational technologies to support creative exploration of very large datasets within an immersive multimodal 3D environment - the eXperience Induction Machine (XIM) [4].

According to Mednick [5], novel ideas (creativity) are generated by identifying new combinations of associated elements that fulfil particular criteria. Creativity is reported to comprise a number of stages [e.g., 6]. Whilst CEEDs plans to support each stage, particular emphasis is given to supporting the ‘incubation’ stage. At this stage, the information related to the problem being considered is not consciously attended to. Unconscious (implicit) processing is very good at detecting patterns and salient (meaningful) signals and predicting outcomes, and there is evidence that unconscious factors can guide the discovery process [e.g., 7].

Thus, in addition to using interaction technologies based on explicit user input (e.g., gesture, verbal responses/speech, motion and manipulation of tangible representations), CEEDs plans to derive indices of unconscious processing such as heart rate, skin conductance (arousal) and brain activity. Unobtrusive multi-modal wearable technologies will be used to collect such responses. Constructs such as interest, attention, rule violation, intensity of experience, emotional response, and preference will be inferred based on an understanding of their neural and physiological correlates informed by empirical research conducted in the project. Depending on the specific goal of the CEEDs experience, user responses to data will be used to guide their discovery of patterns and meaning in the datasets. CEEDs aims to achieve this by developing an explicit model of consciousness to inform a computational model which will be deployed as the CEEDs ‘Sentient Agent’.

Merging the Delivery of Presence with the Study of Consciousness

CEEDs proposes that in immersive mediated environments, presence (e.g., the perceptual illusion of non-mediation [8]) can be induced with stimuli (physical and virtual) by deploying a number of principles that govern our understanding of conscious experience. The CEEDs Sentient Agent, derived from an explicit model of consciousness, will a) process the implicit and explicit responses of users to data presented in an immersive environment and, b) using specific parameters, define how these user inputs are analysed and presented to users by enhancing presence. In effect, it will guide users in their data explorations; by interacting with their implicit and explicit reactions, the CEEDs Sentient Agent aims to support discovery of new combinations (patterns) in the dataset by using different interaction modes. ‘Abduction’, a form of inference whereby a hypothesis is generated to account for observable data [9], will be facilitated in CEEDs by supporting incubation and the principles that govern our understanding of conscious experience, to support users’ scientific discovery.

Collective Discovery System

Collective exploration, creativity and understanding aims to be fostered by CEEDs. Individuals’ pattern detection abilities will be augmented by linking multiple users together, creating a collective discovery system. Components of the CEEDs system will be integrated using approaches from the field of network robotics, creating a genuinely novel approach to massive distributed synthetic reality applications.

CEEDs USES CASES, SCENARIO AND REAL WORLD APPLICATIONS

CEEDs will validate its approach and effectiveness at both scientific and technological levels through a number of real world applications in domains such as: archaeology and neuroscience, for experts to better understand data interrelationships; history, for expert user groups and public information displays; and in commercial (retail) contexts, for use by groups such as consumers and product design teams.

Three of these application areas involve stakeholders who are partners in the CEEDs project (partners with backgrounds in archaeology, neuroscience and industry/retail). Other stakeholders external to the project are invited to engage with the consortium by providing expert advice (e.g., on use cases and scenarios to identify end user needs), and supplying large scale datasets for use in the project. Scenarios of use will vary across applications: some will be directed at expert users as a tool for scientific discovery, other scenarios involve novices, or members of the general public to provide a learning/educative environment. For instance, in the field of neuroscience, CEEDs will allow scientists to explore dynamic graphical models of brain connectivity data using their unconscious reactions to guide and change the display. In archaeology, experts hope that CEEDs will accelerate the speed in which they can identify commonalities in discoveries and to improve tactile representations of discoveries. And in commercial contexts, CEEDs offers manufacturers the opportunity to understand customers’ reactions to their products, to speed up product development time. In addition, an individual’s preferences based on their responses to data will be used to develop the CEEDs Universal Personal Preference (CUPP) files. With the user’s permission, CUPP files could be accessed by the user through their personal mobile phones/PDAs to receive services that are more tailored to their historical behaviours and interests.

MULTIDISCIPLINARY APPROACH

This collaborative project involves experts in relevant disciplines across Europe including 16 partners across 9 countries.

In order to achieve the project’s objectives, the CEEDs Consortium will follow a multi-disciplinary approach that will significantly further the state of the art across science, engineering and the humanities. CEEDs integrates long-term research in scientific disciplines (psychology, neuroscience, cognitive science, robotics, computer science, engineering and humanities) and in information and communication technology (ICT) related research areas (artificial intelligence, pervasive computing solutions, mixed/virtual/augmented reality, smart textiles, signal acquisition and processing, data mining, speech processing, media interface and technologies). CEEDs is based on the belief that only a concentrated multi-disciplinary effort can render the concepts, methods and technologies that will make human-computer confluence a reality.

TIMELINE

This 48 month project funded under FP7 commenced in September 2010 (Project number: 258749; Call (part) identifier: FP7-ICT-2009-5).

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