A Temporal Interaction Framework

Incorporating Temporality into Interaction Design Methodology

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Abstract: The concept of temporality has been explored in theoretical work such as cognitive science, philosophy and logic. In interactive system design, however, there is no well-established method for incorporating the temporal dimension. The goal of this research is to develop a methodological framework for interactive systems design that incorporates the temporal dimension in order to enhance experiential qualities as well as the accessibility and efficiency of a system's use. To develop a methodological framework for interaction design, the research will: 1) identify the concept of temporality as a qualitative process by focusing specifically on images or imagery as an interface between a human and information; 2) develop a qualitative process model for temporally evolving state transitions while a user uses an interactive system; 3) propose a methodological framework incorporating the temporal dimension by investigating theoretical works including Qualitative Process Theory, Temporal Logics, and Situated Action Model; and 4) design a simulator to evaluate a proposed framework.

Key words: Temporality, interactive system design, interaction design, design methodology

1. Overview and Conceptual Foundation

1.1 Image as a Representation of Temporality

"Every problem-solving effort must begin with creating a representation for the problem" [12]

In the mass information era, understanding how human can effectively access and use large amounts of information becomes critical. When using interactive media, a user communicates with others as well as with machines, by receiving, creating, manipulating, and transmitting information. Without properly representing the information as images in spatio-temporal dimension, people cannot effectively interact with the systems to achieve their goals. To explain this mechanism, Deleuze introduced a theoretical approach replying on two concepts which he called "Movement-Image" and "Time-Image". This approach provides a way of understanding duration as an image. The time-image needs to get beyond the "real" no less than beyond the movement [10]. In the Human-Computer Interaction fields, Savaena [13], who introduced the concept of Interaction Gestalt, investigated the relationship between image and temporality. In addition, at the moment when a user meets the images, he/she may experience temporality subconsciously. Ruhnau [14], in further work

exploring the relationship between consciousness and temporality in biological psychology, studied. In experimental work on different sensory modalities, she gathered empirical evidences showing that this is a difference between the internal experience of time and external, physical time. She asserted that the perception of temporal order is linked to a central processing mechanism.

1.2 Temporality as a Qualitative Process

Time in theoretical studies is characterized by two perspectival paradigms: objective (quantitative) and subjective (qualitative) [5]. From the objective view, time has a physical and quantum unit; from the subjective view, time has a relative unit. Following the above approach, temporality also can be classified into two types: qualitative and quantitative.

Temporality can be analyzed within interactive systems by several theoretical studies such as Forbus's Qualitative Process Theory and Temporal Logics by McDermott and Allen [1,2,7]. Qualitative Process Theory (QT Theory) [4] aims to describe the qualitative reasoning about processes. The QT theory introduces a new qualitative representation for quantitative space. Forbus proposes the QT theory as a window to examine interactions described through properties of processes, rather than properties of devices. Allen [3] describes an interval-based temporal representation and defines its mechanism as a temporal component of events: Time is represented as a set of intervals and the relationships between them. The interval-based temporal representation properly works within the framework of Forbus's QT theory. Following this analysis, as a result, a pragmatic framework for incorporating temporality into interactive systems design can be developed.

1.3 Process as An Action Model within Interactive Systems

> *"Communicative action occurs in particular moments of actual time, in particular relationships of simultaneity and sequence. These relationships in time, taken together, constitute a regular rhythmic pattern. This regularity in time and timing seems to play an essential, constitutive role in the social organization of interaction."* [11]

To apply the ideas of temporality as a qualitative process, a model can be developed as an intermediate step. To develop this model, the following research has significant implications: McCullough's [8] concept of embodied interaction; Nardi's [9] notion of the Situated Action Model as a tool that focuses on the people's understanding of changing conditions; Simon's [15] assertion that the Situated Action can be represented by using symbolic-systems viewpoints; and Gasson's [6] further assertion that in terms of a process, "from problem solving in a rational sense, the Situated Action perspective views design as a cyclical process of learning about a situation." In this sense, the Situated Action Model can be used as an architectural instrument in developing the model of temporality for Interactive Systems.

2. The problem domain

Users are creating, exchanging, and manipulating information in operating computational media on various information appliances. Since advanced technologies offer users enormous amount of information in various

forms, designers of such systems need a new interaction paradigm for users. How much information can be manipulated by a user at the same time? How can a user efficiently access information in interactive systems at any point in time?

Another critical issue for system designers is to understand temporal mechanisms of interaction as well as the basic nature of a media system. Today, users can acquire information everywhere and anytime, which increasingly causes uncertainty and error while working with interactive systems. However, current theoretical and pragmatic approaches for interaction design are mainly based on the classical computer system model rather than emerging ubiquitous technologies. For example, one of the criteria to evaluate usability in the field of Human Computer Interaction is effectiveness. For measuring effectiveness, time is one of the unique measurements. The traditional viewpoint, however, is limited to only external physical time and reaction time as calculative units. However, users' perceptions of a time duration, for example, depends on their own internal experience of time. How can designers consider the individual perceptual times of users when designing interactive systems? And what is the threshold of effectiveness?

The focus of this research is to improve interactive systems in terms of information organization and manipulation capabilities by introducing a temporality-based framework to provide effective use of information through user-machine interaction.

3. The research goal and the methodological approach

The goal of this research is to develop a temporality-based framework for representing an interactive system use by defining the concept of temporality in interactive systems, developing a methodological framework, and presenting a temporal modeling process for designing interactive systems.

The research will follow the following phases: 1) study literature reviews to identify the relevant meaning of temporality; 2) through theoretical reviews, develop a conceptual framework for temporality for interactive systems; 3) develop the structure of temporality by using existing approaches such as temporal logics; 4) embody a temporality-based model by using existing process modeling; 5) finally design a simulator evaluation.

4. The future direction of how to carry out the research

The scope of the future work will include 1) social and cultural viewpoints; 2) development of a supportive model of decision-making within a ubiquitous environment. A few case studies will be conducted for conceptual development, and compact design cases will be developed for demonstration and verification of the proposed framework and methodology.

5. References

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