Time Design

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ABSTRACT
The goal of this workshop is to explore and support the design of temporal aspects of interactive systems. Time design is an emerging research and development domain that emphasizes the functional, causal role of time in human-device interaction. It draws on a diverse literature on time in cognitive psychology, psychophysics, sociology, computer science, engineering, Human Factors and HCI. Contributions from each of these disciplines are invited so that preliminary design recommendations can be distilled and an interdisciplinary research agenda can be defined. The discussion will be centered around several scenarios that highlight the temporal characteristics and requirements of different application domains.

Author Keywords
Time design, interface design, system response times, task analysis, multi-tasking, real-time systems.

ACM Classification Keywords
H.5.2 User Interfaces: Evaluation / methodology; H.1.2 User / Machine Systems: Human factors.

INTRODUCTION
Research interest in temporal aspects of HCI has waxed and waned remarkably over the last three decades. After a phase of intense work in the 1970s and early '80s (primarily on system response time, see [10]), output almost subsided from 1985 onwards (see e.g. [3] for exceptions). This trend coincided with the move from time-shared computer systems to "Personal Computers", and only reversed in the late 1990s with the proliferation of the Internet. Despite this groundwork of HCI research, and a growing timing literature in other disciplines, time is still often viewed as merely a *descriptive* property of interaction. While this perspective has spurned useful methods for modeling the duration of elementary actions and cognitive operations [1], or the sequential structure of tasks, it fails to take account of the *functional* role of time, where time is relevant as a work requirement or constraint, as information in a control decision, as the outcome of such a decision, or as a property of a task, interface or agent – with particular emphasis on human agents and their time use characteristics, reactions to time stress, and biases in time perception, temporal reasoning and temporal memory. This richer notion of time supports the exploration of time design choices (e.g. related to the pace of interaction, temporal validity of information, interruption scheduling, temporal reference systems synchronization, multi-tasking, the regularity, periodicity and interleavability of tasks) and the effects of these design options on user behavior (e.g. in terms of anticipative vs. reactive control mode, attention management, or temporal errors). Establishing time as a design feature of interactive system is particularly relevant as

- Interface elements become increasingly dynamic (c.f. discussion of the manipulation of time in [11])
- Response delays are still a considerable problem, especially in mobile devices
- Time can be used to make inferences about non-temporal aspects (e.g. aliveness) and vice versa
- Computer systems are used in safety-critical systems with hard real-time requirements
- The sequential structure of tasks becomes increasingly complex (e.g. multi-tasking and interleaving)
- Temporal error is an important aspect of human error [6]
- Scheduling and temporal control is an ubiquitous aspect of human behavior

AIMS OF THE WORKSHOP
The workshop aims to map out the temporal dimensions of the design space by making explicit the time design choices, or the temporal implications of design choices, in a number of scenarios drawn from different application domains. This process will be informed by temporal phenomena identified in a variety of research disciplines. The relevance of empirical results, models and theories of time use (e.g. [8]) for the design process will be discussed. The contribution of existing representation, modeling and analysis methods will be assessed, and requirements for dedicated time design methods will be outlined.

APPLICATION DOMAINS

Tasks and operational environments differ greatly in their temporal characteristics. Therefore the first step in a time design development process is to identify the temporal requirements and constraints of the particular task or domain. To highlight this diversity, several scenarios will be provided that shall form the basis for discussing time design choices and trade-offs. They include:

- CSCW (concerned with issues of synchronization, pace, social time, and interruption handling)
- Computer-based training (promoting thorough work style by introducing temporal decision costs)
- Enjoyable interfaces (aesthetics of time; lessons learned from the temporal structure of film, music, conversation, humor)
- Process control (interface features supporting anticipative control, perception of temporal costs, temporal reasoning)
- Online traffic information for public transport (perception of waiting time; time use strategies; temporal validity)

RESEARCH DOMAINS

Time design relies on a broad, multi-disciplinary literature on the functional role of time in human behavior. Each of the scenarios will be viewed from different perspectives (e.g. social, psychological, engineering), and strategies for converting the relevant research knowledge into design methods, models and tools will be discussed. The relevant research domains include, but are not limited to:

System response times

Research in this area suggests that there is no one-to-one relation between response delays and perceived Quality of Service. Instead, task and interface characteristics, user expertise and goals, and the regularity and distribution of delays are important moderating variables [10]. Sometimes it can be useful not to reduce delays as much as technically possible, as a fast response time can induce a faster (and sometimes less thorough) work style [7]. "Lockout" periods have been shown to improve the quality of decisions [9].

Human Factors

In Human Factors, too, time is an under-researched topic. Hollnagel [6] notes that "few of the existing action and error taxonomies include the aspect of time […] In many domains it is, however, necessary to include time […] as, perhaps, one of the principal 'mechanisms' or 'error areas' of human action". Recent contributions on temporal awareness [4], temporal reference systems [2] and dynamic function scheduling [5] are directly relevant to the time design agenda.

Cognitive psychology

A growing literature on temporal factors in judgment and decision making [e.g. 12] suggests that conventional utility models, where costs and benefits are usually described in terms of money or similar commodities, may not be valid models for describing the perception of temporal costs. Duration neglect appears to be a common phenomenon both in temporal reasoning and temporal memory.

Representation and analysis

Task representation techniques are well equipped for modeling the sequential structure of single tasks. However, so far no technique adequately supports the representation of multiple concurrent or interleaved tasks and their durational properties. Of particular interest is the modeling of strategy switches where multiple tasks are no longer executed as a collection of single tasks, but transformed into a new compound function. Queuing and scheduling models, on the other hand, support the analysis of multi-task environments, but usually treat tasks as atomic units with no representation of their sequential structure. The workshop will discuss the feasibility of integrating these types of approaches.

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