User Tasks Description: a Retrospective, Recent Contributions and some Research Challenges

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ABSTRACT

Describing users tasks has been the focus of research for many years starting with the seminal work from Annett and Duncan in 1967 [2]. Since then, the Human Factors and Human Computer Interaction domains have proposed multiple contributions identifying the elements that have to be gathered and represented in order to describe precisely the relevant aspects of users tasks. This keynote will highlight these fundamental elements of tasks descriptions and will state the current state of the art. A specific view on how to use such descriptions to design and assess automation will be given. Some publicly available tools will also be presented together with their use in various industrial application domains. These applications will be the opportunity to identify remaining research challenges for tasks description and modeling.

Author Keywords

Task descriptions; task modeling; task-centered design; task-centered evaluation.

ACM Classification Keywords

CCS Concepts: • **Human-centered computing → Human computer interaction (HCI)**; *Interactive Systems and Tools*

HISTORICAL PERSPECTIVE

Tasks Analysis and Tasks Representation are cornerstones of User Centered Design approaches, aiming to collect information from users goals, work and activities. According to Johnson [16] "any Task Analysis is comprised of three major activities; first, the collection of data; second, the analysis of that data; and third, the modelling of the task domain" (p.165). While this work emphasises the importance of data, it is important to note that users' work is mainly a procedural activity. The means (notations and tools for representing the outcomes of task analysis) have important implications for the value and insight gained from the process, not least because any omissions cannot be discussed (among the stakeholders) or taken into consideration in later design phases.

The expressive power of the notation used to store and organize the information collected is thus a key element that is put forward by researchers proposing new notations [4]. Since the seminal HTA notation proposed by [1][2], relatively few notations to describe user tasks have been proposed and they all tend to remain unchanged after their creation. While the notations remain largely constant, their associated tools typically evolve to address new challenges. For instance, Paterno's team has proposed several tools exploiting CTT notation since its creation in 1997 [35]: the original CTTe tool **Error! Reference source not found.** supported editing, simulating and verifying CTT task models; CTTEVis [36] added support for visualization; and a new tool added support for collaborative modelling [20]. The stability of notations contrasts with the constant evolution of application domains, technologies, and the nature of work operators' work. This evolution can create a gap between what the notation can describe and the actual work, limiting the scope and potential benefits of using the notation at all. For instance, a notation like KMAD [4] or CTT [35] would produce the same representation of tasks for interacting with a calculator regardless of whether the calculator was a physical device, a desktop application, or an app on a mobile phone. This lack of precision and detail make it impossible for analysts to assess the interaction implications of moving from one technology to the other one.

This is heavily constrated with the work on the HAMSTERS notation that was designed after the fundamental elements of users' tasks descriptions were identified and incorporated in notations.

HAMSTERS was built exploiting these fundamental elements that are:

- Hierarchical structure of tasks: Hierarchical Task Analysis [1] [2],
- Knowledge representation: Task Knowledge Structure [17],
- Multi-user/Collaborative activities: Groupware Task Analysis [40].

In order to address the challenges brought by new technologies, for each of the fundamentals elements above, HAMSTERS was extended to represent much more precise information:

- Tasks structuring using sub models [27] and components [10]

- Detailed knowledge and information representation [26] ;
- Synchronous, asynchronous, same place, different place collaboration [21].

More rencently, HAMSTERS notation and its associated tool HAMSTERS|XL have been released to allow human factors analysts to customize the HAMSTERS notation to the needs of the application domain or the interactive systems they are addressing. For instance, in [8] the HAMSTERS notation was extended to address the specificities of Cyber Physical Systems.

EXPLOITING TASKS DESCRIPTIONS

The following non-exhaustive list identifies some of the objectives of task analysis, highlighting its broad range of uses:

- Identification and description of the required functions for interactive system [13] [35],
- Identification and description of knowledge required to perform a task [7] [17] [26] [38],
- Identification and description of the temporal ordering of the user actions with the system [18] [22] [35],
- Identification and description of the different user roles and actors for groupware systems [37] [40],
- Identification and description of workflow between users for collaborative activities [37] [40],
- Understanding of an application domain [34],
- Recording the results of interdisciplinary discussions [30] [34],
- Production of scenarios for user evaluation [41] as well identification and generation of relevant test cases [6],
- Heuristic evaluation of usability of interactive applications [5] [37],
- Predictive assessment of task complexity and workload (motor, cognitive, perceptive) [29],
- Predictive assessment of user performance when interacting with the system [15],
- Exploration of the range of ways in which the system may be used [37],
- Preparation of training programs [1] [2] [25],
- Production of user manual [12] [33] and contextual help [14] [31] [33] [34],
- Identification and description of possible allocation of functions and tasks between the system and the user [23] [32],
- Designing new applications consistent with the user conceptual model [34],
- Identification and description of potential user errors [9] [39] [42] [24],
- Assessing other properties than usability as, for instance, dependability [43], security [44] or user experience [45].

Task analysis is thus a pillar of UCD approaches for the design of interactive systems. If the results of task analysis do not contain sufficient information, the missing information may negatively affect the design of the interactive system and its usability.

CHALLENGES AHEAD

The main challenge ahead of users' tasks representation lays in the fact that there is reluctance to use this tool that requires deep understanding and description of users' work.

Beyond, curricula like the ACM 2013 Computer Science curricula that exhibits multiple courses on Human-Computer Interaction does not even mention the need to analyse and represent users' tasks [3]. There is still a long road ahead before seing widespread use of task modeling noations and tools but the path created by CTTE which offered the first publicly available tool increased the takeup-ability of the multiple benefits of users' tasks representation.

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