ERCIM Collaborative Interaction Design Toolset

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Abstract

This position paper aims to present a proposal for collaborative long term research amongst ERCIM members in the context of the current ESPRIT Call on Intelligent Information Interfaces (I^3). The paper outlines work proposed to be carried out in the context of the *Connected Community* Schema of ESPRIT Intelligent Information Interfaces initiative. The proposed work is primarily concerned with the way in which a specific community (such as for example the user interface design community within ERCIM as well as other corporate organisational or institutional working communities) may progressively and incrementally consolidate accumulated wisdom into reusable, sharable and expandable knowledge repositories. As an example, we provide a tentative scenario of such a community emphasising core activities, the issues to be addressed and the benefits to be obtained through suitable technology.

INTRODUCTION

In the recent past, there have been several visions about the next generation of user interfaces and their underlying architectural properties. FRIEND21 has been one such effort which has laid out a detailed set of Human Interface Architecture Guidelines, thus sketching the concepts and principles underlying the user interfaces of the 21st century. The relevant literature, points to several other claims and visions whose elaborate treatment is beyond the scope of this brief document. Along these lines, the ERCIM working group on User interfaces for All has provided a forum for discussion and exchange of ideas on this important issue. To this effect, representatives of the ERCIM member organisations have contributed to this forum by presenting their current and forthcoming research efforts, in the course of the 1st workshop of the working group, held in Crete in October 1995.

In addition to establishing a forum for discussion and exchange of ideas, the ERCIM working group on *User Interfaces for All* (UI4ALL) seeks to develop further, so as to facilitate collaborative research and development amongst member organisations in the context of the European Union's Information Technology Programme. To this end, ERCIM members are now called to consolidate existing material and develop proposals for collaborative research and development in the broad context of I^3.

One prominent paradigm shift in the domain of user interface and human computer interaction is the shift from programming to designing interaction artefacts suitable for the target domain and the intended user group. One noticeable effect of this shift is that the traditional artefact-oriented design process is increasingly becoming obsolete. Design teams realise the need for reusing past design experience, design rationales and solutions and articulating them in a manner suitable for the new problem at hand. This implies that design teams can no longer be artefact-oriented, but need support in accumulating the existing design wisdom into shareable, reusable and expandable knowledge repositories, facilitating short- and long-term collaboration over design problems as well as an organisation/community wide living design memory.

DISTRIBUTED INTERACTION DESIGN: A process of negotiation

In what follows, we briefly overview the user interface design community as this may be instantiated in the context of a corporate multi-unit commercial organisation, or an institution. The term design community, in this context, entails a group of stakeholders possessing different expertise in the various fields contributing concurrently to the design of information interfaces. By this definition therefore, domain experts, interaction designers, human factor specialists, interface developers, usability experts, user representatives and management may be considered as the stakeholders who have to co-operate and collaborate at different stages to solve a particular design problem. In such a community, members need not necessarily be co-located, while their role is effectively to provide specific expertise (i.e. human factors knowledge, design knowledge, evaluation knowledge, user-specific knowledge, domain-specific knowledge, etc) or services to the rest of the design team upon request.

At any instance, the team members may be working at different levels of detail, each employing his or her own representations of physical artefacts, engineering models and knowledge. For example, the human factors expert may be concerned with the cognitive dimensions of an interface, while the interaction designer may be attempting to solve syntactic (i.e. command sequence) or lexical (i.e. selection of appropriate feedback modalities) details of the dialogue. Each member's task may also be supported by different computational systems (e.g. the cognitive scientist may be experimenting with device simulation software or a design rationale tool, while the interaction designer may utilise a popular multimedia presentation design tool offering quick edit-refine-view facilities for dialogue syntax or even a toolkit with parameterised object model for determining dynamic behaviour or look and feel).

In such a setting, it becomes evident that design is a process of negotiation: decisions are made and changed frequently as specifications change and new ideas are brought forward. The notions which would prevail in such a setting would include *co-operation* amongst members to define, elaborate and specify a problem as well as *collaboration* (both short-term and long-term) to solve the problem. Some of the key activities that members of the community will have to undertake include *review* and *assessment* of design histories and rationales, *consolidation* of accumulated wisdom, *propagation* of available knowledge into new design problems, etc.

INTEGRATION OF HUMAN AND TOOL PERSPECTIVES VIA SHARED DESIGN MODELS

Such a community could be empowered by being provided with computer-based tools which support the above activities at all levels (including the process, the artefact and the history trace). More specifically, members of the community would benefit if they had a common and agreed codified knowledge to act as a communication medium between (i) different people and stakeholders; (ii) people and implemented computational systems; and (iii) different implemented computational systems (including modules such as DBMS, spreadsheet). In addition, such a common and agreed codified knowledge pool would assist (a) acquisition, representation, and manipulation of community knowledge; such assistance is via the provision of a consistent core of basic concepts and language constructs; (b) structuring and organising libraries of knowledge; as well as (c) explanation of the rationale. In addition to building such domain-oriented and codified knowledge schemata, designers should also be provided with tools to allow depositing new knowledge compliant to the agreed schema, depositing new design experience and accompanying rationale, propagation of tentative design changes, as well as collaboration tools for message broadcasting and exchange. Such tools will help community members share knowledge and keep track of each others needs, constraints, decisions and assumptions.

Such a community may be supported by technology in the extend to which the latter provides the mechanisms and tools to capture and describe the accumulated wisdom of the design community and to facilitate an effective medium for knowledge sharing, reuse and expansion (i.e. depositing new information).

OBJECTIVES

While the design of interfaces is pre-dominated by several computer-based tools or software suites it is commonly known that such software components do little to facilitate information sharing and coordination. Most of these tools support specific tasks in the development cycle of interactive applications (e.g. layout generation, task analysis, specification, code generation, usability evaluation, etc) while in the vast majority of the cases such tools fail to encapsulate the rationale behind tentative design solutions. Moreover, their suitability for knowledge integration, reuse and sharing is severely questioned. On the other hand, with the shift towards designing as opposed to programming interactions, it becomes evident that designers require support for short- and long-term collaboration with other user interface design stakeholders contributing new knowledge from various disciplines (e.g. human factors, software engineering) into the task of designing and developing an interactive application.

Consequently, the proposed work aims to provide a flexible infrastructure for knowledge-based, machine-mediated collaboration between disparate user interface design members and tools. The work proposed therefore aims to provide a medium that allows designers, through their tools, to accummulate, consolidate, share and propagate user interface design and development knowledge spanning the functionality of the individual tools. More specifically, the proposal describes a computer-based toolset which will enable, amongst other things, capture and description of the selected community in terms of its members, activities, goals, norms, constraints, etc; sharing of and access to community-wide information; and creation and deposit of new information through intuitive interaction paradigms (living community memory). The distinctive characteristics of the proposed work is its emphasis on distributed engineering knowledge rather than a centralised knowledge base. That is not only the proposed work avoid the requirement for physically centralised knowledge, but the modelling vocabulary is distributed as well, focusing knowledge representation on specific knowledge sharing tasks.

CONTEXT

The proposed work focuses on two primary themes, namely *community as database* and *active participation* within a community. The first theme entails that community knowledge is distributed and spans across the various members of the community. Consequently, shared representations of this knowledge will bridge alternative perspectives imposed either by humans (e.g. engineering model followed) or machines (i.e. the narrow perspective of a particular tool) and facilitate the evolution of knowledge as an organisational asset which grows together with the community. One important issue regarding this theme is the facilitation of novel means for co-operation and collaboration amongst community members via computer-based tools which break through the boundaries and shortcoming of the current interaction paradigm and enable active participation and communication between individuals. This leads to the next theme, namely active participation of community members into the evolutionary process of community growth. Such a theme entails that community members are provided with appropriate computer-based toolset to access, browse and retrieve community-wide information, but most importantly, they are supported in depositing history traces and other new knowledge into the community-wide information pool. This renders the underlying knowledge repositories “living knowledge servers” for the benefit of the specific community and other communities.

A schematic depiction of the target community-wide environment is illustrated in the diagram of Figure 1. The diagram shows on the left hand side the existence of a community of designers who need not be co-located. They all have access to a network wide computer-based toolset facilitating short-term and long-term collaboration over various design problems. On the right hand site, an overview of the main building blocks of the collaborating functionality toolbox and associated tools allowing the design community to perform its task. In what follows, we briefly review each of the components identified in the above diagram with the objective of enlightening their role and purpose within the overall architecture.

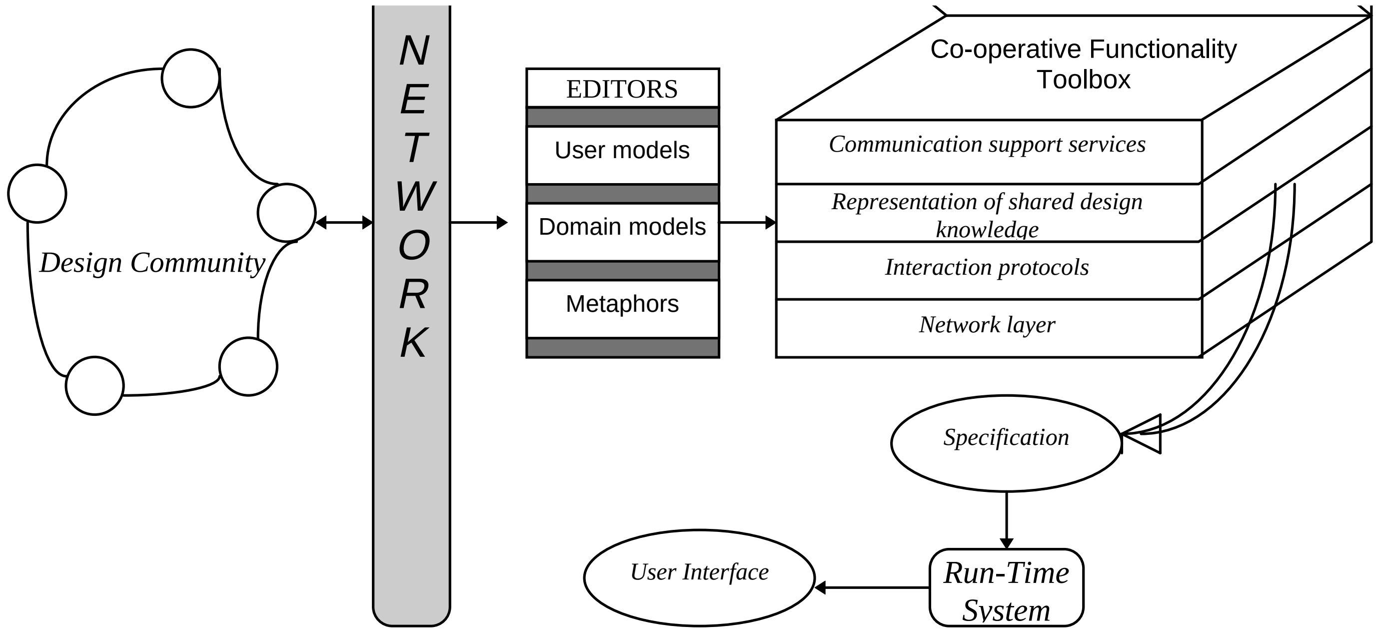

Fig. 1: Overview of the architectural abstraction of the proposed work

The design community

As already pointed out, the proposed work aims to provide support for a community of interaction designers (as they form a part of a wider working community within an organisation or institution), in developing interfaces to information in the emerging interaction-intensive human-computer collaboration paradigm. There are several aspects of this community which make it interesting, over an above those already mentioned (e.g. disparate membership, co-operation, collaboration, multidiscipline). First of all the community is largely non-homogeneous in terms of the background, expertise, computational systems and underlying targets of its members. Secondly, the community is formed from representatives of other communities (i.e. user community, management) within a corporate organisation or an institution, thus the differences in perspective. Finally, the community under consideration, irrespective of its non-homogeneity, is responsible for the design, development and maintenance of intelligent information interfaces, exhibiting intuitive and high quality of interaction. Therefore, the community at the level of the individual, but also as a whole, needs to develop a good understanding of the factors at play and the state of the art in technology. At the same time it is content to operate under constraints imposed either by humans (e.g. members of the community), computational systems (e.g. tools), task requirements and the end users of the artefacts developed.

The Co-operative Functionality Toolbox

In this part of the paper the objective is to briefly outline the main components of the software architecture to be developed, as well as some functional properties of the constituent tools. It is important to mention, some of these tools are not intended to provide designers with new computational systems for designing interactions. Instead they are tools necessary to facilitate information integration within the selected community, while at the same time allowing designers to use specialised software environments (i.e. tools) to address problem-specific issues. Consequently, the architectural components depicted in the diagram of Figure 1 are at the knowledge-level. This means that even though different designers within the community may use different tools (e.g. ProVision, or Visual Basic, or a dedicated toolkit), their interactions with the co-operative functionality toolbox will comply with the knowledge-level components depicted in Figure 1. In other words, knowledge exchange, message passing, negotiation protocols etc., will be carried out in a predetermined and universal manner to be specified in the context of the proposed workplan. What is to be developed therefore is primarily concerned with the knowledge-level interactions, their semantics, syntax and visualisation.

Such knowledge-level interactions will however require a new infrastructure which is to be developed in the course of the proposed work. The distinctive component of this infrastructure will be the co-operative blackboard studio, which will provide the backbone for knowledge sharing and reuse, message exchange, agent communication and facilitation services (e.g. negotiation, collaboration, routing), etc. The co-operative studio will build upon and integrate existing technologies in the area of knowledge sharing and reuse, to cope with the requirements of the various layers of the co-operative functionality depicted in the diagram of Figure 1.

Another important development constituting a component of the co-operative functionality toolbox is the construction of generic core of shared design constructs (i.e. design vocabulary). This knowledge resource will facilitate the capture of common conceptualisations among domain specialties; encapsulation of data and models supported by the underlying tool environments used by members of the community; an evolving living design trace for the community; as well as a common understanding of design issues and constraints. This shared community-wide knowledge repository will capture the relationships between components, constraints, and parameters of a design space, while it will be constructed in such a way so as to provide both a formal specification of nontrivial problem-solving tasks and a domain theory (a design space knowledge base).

A final component of the overall architecture is the run-time system for generating the code for intelligent information interfaces. In the current paradigm of user interface development, although the programming effort has been substantially reduced, there still inherent shortcomings which need to be addressed so as to (a) reduce implementation of user interfaces to specification and (b) enable generation of user interfaces from first-class design principles.

Reducing implementation to specification introduces several challenges including the development of powerful specification techniques capable of handing, amongst other things, syntactic and lexical polymorphism, coupled with unified programming interfaces. With regards to the generation phase, it needs to become more sensitive to the shared design knowledge repository in order for design principles and recommendations (such as the choice of interaction metaphor, object classes and task sequencing) to be directly accounted and embedded into user interface implementation. The construction of such a user interface generation engine will utilise various user interface management system technologies to facilitate intuitive, natural, co-operative and intelligent interaction with information.

DEMONSTRATION AND PROTOTYPES

The concepts and principles advocated in the proposed work will be demonstrated by means of a realistic scenario to be fully described in the course of the project. In any case, the scenario will effectively build upon a real design community formed out of representatives of the participating partners in the consortium. A non-trivial design problem will be selected for experimentation and the supporting tool environment will be tailored to the needs and requirements of the selected problem domain. Prior to demonstrating the full-scale system, prototypes of the underlying software components will also be developed for review and refinement.

CONCLUSIONS

At the core of the vision of User Interfaces for All is a mix of existing and emerging technologies which are likely to predominate the life cycle of future user interfaces to a wide range of applications and services; these interfaces must be both accessible and high quality so as to be usable by a diverse user population, including people with different cultural, educational, training and employment background, novice and experienced computer users, the very young and the elderly, and people with different types of disabilities, in various interaction contexts and scenarios of use. Therefore, User Interfaces for All is primarily concerned with two usability requirements, namely universal accessibility and high quality of interaction; both of these have surfaced for a number of years, but are not adequately addressed in the present paradigm for UIST. The rationale for the current proposal under User interfaces for All is grounded on forthcoming changes in the pattern, style and model of interaction likely to emerge as a result of: the increasing complexity of human-machine dialogues; the increasing knowledge-based nature of tasks resulting from the radical amendments in both the nature of work and the content of tasks; the increasing number of computer users characterised by diverse abilities, requirements and preferences; the wide proliferation of lexical technologies incorporating advanced interaction facilities, novel input/output devices and multimodal interaction techniques based on advanced multimedia interaction technologies. These contemporary developments raise a compelling need towards sharable and reusable design knowledge repositories, encapsulating data and models of dedicated component software tools, while preserving the individual tool's view and perspective upon design.