

## Task 2.1: HCI Taxonomy, Summary of Work at CCI

### Introduction

Work at CCI during the first year of GRACE has aimed at reviewing part of the literature in the field, elaborating and extending the GRACE research agenda and taking a number of steps towards its implementation. The GRACE research agenda now looks as follows, with agenda items listed in order of increasing complexity:

- (1) to establish sound foundations, both conceptually and in terms of an operational taxonomy, for describing and analysing any particular type of unimodal or multimodal output representation relevant to human-computer interaction (HCI);
- (2) to create a conceptual framework for describing interactive computer interfaces so as to cover both input and output of information;
- (3) to apply the results of steps (1) and (2) above to the analysis of the problems of information-mapping and information-transformation between work/task domains and human-computer interfaces in information systems design.

As compared with the GRACE Technical Annex, two important commitments have now been clearly made. These are: (a) to address the field of multimodal systems in general and (b) to treat the investigation of input modalities as a separate item on the research agenda which will be addressed during the first half of the second year of GRACE.

### State-of-the-Art Overview

As to GRACE agenda item 1, literature surveys have shown much and diverse work on the information representation capabilities of static graphics and graphical interfaces, often combined with written natural language (May 1993a). Solid and useful taxonomic work, on the other hand, is still in its infancy in the field (Twyman 1979, Lohse et al. 1991, cf. Bernsen 1992), the main reason being, it seems, that researchers have concentrated on analysing in some depth the relatively few types of graphics and combined representational forms which are in widespread use in HCI graphical user interfaces rather than taking a more systematic and general approach. This latter approach, however, becomes mandatory when the full spectrum of multimodal output representations are to be addressed and is also mandatory to a systematic scientific treatment of the field. Taxonomies of multimodal systems from a system engineering point of view are beginning to appear (Coutaz et al. 1993, Nigay and Coutaz 1993). Their results are compatible with our own (Bernsen 1993a).

As to GRACE agenda item 2, a literature survey will be done early into the second year of GRACE. Work on agenda item 2 will have to address not only individual input modalities *per se* but also the information representation and exchange capacities of full input/output interactive setups supporting real task performance. We hope to be able to incorporate results from the GRACE partner in Amsterdam to these ends.

As to GRACE agenda item 3, basic and systematic conceptual work on information-mapping between task domains and interfaces seems only to have begun recently. Thus, the most promising approach we have identified (Hovy and Arens 1990) does not address the crucial issue of how the task domain information is to be captured for the information-mapping process to begin. Important theoretical and practical work on the entire information-mapping process has been done at one of the GRACE partners' sites (Leuven) in Esprit project PROMISE, and we are capitalising on these results in collaboration with Leuven (Bernsen and Bertels 1993). This collaboration will be continued throughout the second year of GRACE as it provides eminent opportunities for testing and refining work on concepts and taxonomies in a real interface design environment in addition to the opportunities we have at CCI.

### **Summary of Work**

In addition to the literature surveys, CCI's work in the beginning of the first year of GRACE comprised two strands both designed to chart the concrete requirements of the GRACE research agenda and resulting in its further elaboration (cf. above). One strand was exploratory work on how to address the information-mapping problem in the field of static graphics and written natural language (Bernsen 1992). The work confirmed the need to adopt a systematic conceptual and taxonomic approach to the information representation capabilities of modalities prior to revisiting the issue of information-mapping. The second strand was to build a software workbench for the analysis and classification of static and dynamic graphics representations (May and Bernsen 1993, May 1993d). The workbench was demonstrated at *InterCHI '93* in Amsterdam. A similar workbench is now under construction at HCRC Edinburgh. This work has provided valuable feedback and new ideas for our own efforts.

The second phase of the first year of CCI's GRACE work led to tentative definitions of the concepts of 'pure generic modalities', 'media', 'analogue' and 'non-analogue' modalities, 'arbitrary' and 'non-arbitrary' modalities, 'static' and 'dynamic' modalities, 'linguistic' and 'non-linguistic' representation, 'modality', 'modality structures' and 'modality atoms'. Based on this set of concepts, a taxonomy of pure generic output modalities covering the media of vision, sound and touch was proposed and GRACE research agenda item 1 could be made specific and operational (Bernsen 1993a). The idea is to analyse the set of elements which, either in isolation or in combination with other modalities, go into the construction of HCI output modalities. Work on the GRACE research agenda in its operational form has continued up to M1 and has resulted in a lattice structure of pure modality types (May 1993a,b,e); case studies on how to apply the taxonomy (May 1993c); foundational work on the complementary properties of analogue and linguistic representations (Bernsen 1993b); and a proposed research agenda for the field of modality theory (Bernsen 1993c). Work on completing GRACE research agenda item 1 will continue during the second year of GRACE. We expect to receive valuable input on the static/dynamic distinction from the GRACE partner in Trento.

As compared with the plans in the Technical Annex for joint development of basic concepts and taxonomies between CCI and HCRC, Edinburgh, CCI has had less contact with HCRC than planned during the first year of GRACE. As a result, the conceptual and taxonomic work presented in this Task 2.1 Summary has been uniquely developed at CCI and possibly at a slightly slower pace than anticipated when the

Technical Annex was being prepared. A consequence is that GRACE has not yet succeeded in creating a common conceptual and taxonomic approach accepted by its partners. We hope that it will be possible to move quickly towards this aim during the second year of the project.

The GRACE Technical Annex envisioned use of CCI's 'SITUE' framework for design space analysis in addressing GRACE research agenda item 3. This usability engineering framework, which is now called DSD (Design Space Development), has matured considerably during the past year as a result of parallel work in Esprit Basic Research project AMODEUS 2 (Bernsen 1993d,e). Contacts with the GRACE partner in Leuven at M0.9 lead to the decision to jointly investigate how DSD might contribute to the specification of an operational methodology for information-mapping (cf. GRACE agenda item 3). Annick Bertels from Leuven spent one week at CCI in June 1993 to work with Bernsen on the methodology. The methodology is presented in (Bernsen and Bertels 1993), illustrated by two simple case studies. It has turned out that the application of some workable method or heuristics for scenario generation is crucial to making the methodology work in support of interface design practice. One such method is currently being investigated at CCI as part of AMODEUS 2 (Klausen and Bernsen 1993).

## **Conclusion and Future Work**

The first year's work has helped us to realise the precise scale of the GRACE research agenda. However, the steps taken so far towards its implementation indicate, we believe, that a reasonably thorough exploration of the agenda is feasible within the lifetime of GRACE, especially given the collaboration which has been established with Leuven. The methodology paper (Bernsen and Bertels 1993) has served to emphasize the need to develop taxonomy and concepts concurrently with their application to concrete and realistic examples of interface design. In other words, no single step on the GRACE research agenda can be developed in isolation if the product of research is to be of practical value to interface designers.

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