Adaptive multimodal interaction

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(Project agreements)

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Abstract

This document represents the formal conclusion of the initiation of a new phase for the project 'Adaptive Multimodal Interaction' (formerly known as 'Turn on the Base'). It contains the project definition, proposals for experiments, required activities, deliverables, and results for the 1997 project. The project 'Adaptive Multimodal Interaction' is aiming at theory formation, system architecture and design, and experimental evaluation focused on accessing and interacting with multimedia content in a domestic context-of-use (family room).

Contents

1 Project content

1.1 Introduction

Little attention has been paid how to accommodate user intentions regarding entertainment and information needs in different domestic contexts-of-use. Context-of-use refers to the environmental setting in which systems are used. It is likely that the sheer quantity and diversity of multimedia content itself already implies problems in selection and choice. Not only should this problem be solved by providing the appropriate system functionalities, but also the corresponding interaction should be maximally 'adaptive' and 'transparent'. Adaptivity bears on adjusting system behaviour to make its outcome more suitable as for new use or different contexts-of-use. Transparency refers to the qualitative feeling of control while interacting with a system; a multimodal interaction style is claimed being more transparent than conventional interaction styles.

The AMI project wants to demonstrate and evaluate new interaction styles to access multimedia content in a home environment. A large personal music collection serves as application carrier and platform for experimental research. Project results can be directly incorporated in on-going Philips research projects that focus on the entertainment clusters in the future home (WWICE, EoU). Eventually, findings are considered to be of importance to the consumer electronics portfolio of Philips (e.g. a Multimedia Archiver).

The 1997 project is divided into two phases.

1. The possibility to compile preferred content is a function that must be present on any multimedia device with a large storage capacity (e.g. programming music, creating 'intelligent' tv-zapping list, constructing 'whole-evening-video'). The first phase develops and evaluates an interaction style in which both the end-user and the system share the responsibility, to various degrees, to compile user-preferred music programmes. The usability (effectiveness, efficiency, and user appreciation) of the new interaction style is benchmarked against interaction styles found on current CE equipment.
2. It is often claimed that the benefits of a multimodal interaction style will surpass many problems in usability. However, both from technological and user perspective, the architectural requirements of a full-fledged multimodal UIMS are not yet clear. The second phase develops and evaluates a multimodal interaction style for a set of music archiver functions. For this endeavor, a multimodal UIMS suited for this particular interaction style will be implemented. There will be a co-operation with other Philips research projects dealing with UIMS implementation (WWICE, EoU). Usability of the multimodal interaction style will be revealed by a user experiment.

The funding of the project is based on a contract between IST/IT and the Technical University of Eindhoven. The project is a cooperation between IPO and IST/IT.

1.2 History

The project was initiated as 'Turn on the Base' in November, 1994 by ideas about new functionalities and interfaces for future audio products (Eggen, 1995). As a project result, a strategy for automatically compiling music programmes, named Personalized Automatic Track Selection (PATS), has been implemented. The process of implementing PATS in the diverse project phases has been fully documented (Pauws 1995a, Pauws 1995b, Pauws 1995d, Pauws 1996). A short paper of its formal operations are described elsewhere (Pauws, Eggen 1996). PATS aims at automatically compiling music programmes that are preferred in a specific context-of-use. It is, in addition, assumed that subsequent PATS compiled programmes adapt to the designated context-of-use. Hypotheses on user appreciation of music programmes as compiled by PATS were formulated. A user evaluation supported these hypotheses (Ober 1996, Pauws et al. 1996b), but further experimental evaluation is recommended (Pauws et al. 1996b). In particular, hypotheses on the value and (dis)advantages of personal control in music collection need to be studied.

After the implementation of PATS, spin-off projects were generated and started. A 5-day visit was focused on knowledge transfer and the feasibility of recommended agent-based applications in a networked home storage environment (Pauws 1996c).

An apprenticeship and graduate project addressed the user evaluation of PATS in terms of appreciation and acceptance (Ober 1996).

The project 'Interact with the Base' was considered a derivative and had a one-year leadtime. It aimed at designing and implementing a multimodal interaction style for an audio system mainly consisting of music programmes. A structured design approach was adopted and has been fully documented (Scheffer (1996a), Scheffer (1996b), Scheffer (1996c)).

The project 'Feel the Base' was a short-term apprenticeship project focused on the making of a novel 3-D input device with vibrotactile feedback especially designed for interaction with music programmes as visualised in a three-dimensional virtual world (Sluis (1996)).

1.3 Aim

The Adaptive Multimodal Interaction project will develop new and innovative interaction styles that automatically adapt the presentation of multimedia items to the personal preferences of the consumer.

It will be demonstrated that these new interaction styles outperform functionality found on current CE equipment for compiling and retrieving items from large personal multimedia collections with respect to usability (effectiveness, efficiency, and user appreciation).

1.4 Relevance

The present use of future consumer electronic products in the home will dramatically change. Strategic research and development is now focused on home entertainment: enhanced broad-casting, set-top boxes, in-house digital network, home entertainment systems. It is commonly acknowledged that considering the overwhelming amount of content available in different forms, on different storage media, from different distribution channels, advanced inventions to disclose this to the user have still to be made. The diversity in content might even adversely influence the actual enjoyment of the content.

The very nature of above-mentioned systems affords totally new intentions, tasks, and interactions with multimedia content. First, one should be careful about the fact that users bring along their concepts and expectations from one domain to the other. Second, with regard to product integration, different media are characterised by their intrinsic limitations and mutually diverging possibilities. Third, by relying too much on existing UI concepts and interaction styles (e.g., by adopting notions from the professional work area), biases and unverified assumptions about users and their contexts may be introduced: for this particular domain, interaction concepts may become inadequate, inconsistent, or even obsolete. In general, home entertainment products must gracefully fit in the leisure and home environment to become commercially viable; they must be usable in different contexts-of-use which extends from social norms and values, to user intentions and physical environmental settings.

1.5 Experiments

This section describes two proposals for experiments. Their designs still need to be further refined. The experiments are considered focal points for the project and require the design and implementation of a demonstrator.

1.5.1 First experiment proposal

Although the task of compiling a content programme is considered cumbersome, it is rather unclear to what extent personal control of content selection is valued. A former experiment gave rise already to a number of hypotheses (which could not be tested at that moment) on the locus of control, and the effects it has on the effectivity and efficiency of the compilation process, and the corresponding appreciation. More experimental data is required to reveal to what extent control and its style effects the appreciation of music compilation.

It is assumed here that 'content appreciation' whether it is the enjoyment of watching a specific movie, or listening to music, is affected by a set of six factors.

- *Content.* Appreciation of content is logically determined by the features of the content itself. If appreciation can be ascribed to the content, it is interesting to know what content attributes are relevant, or even cause the appreciation.
- *Personal taste.* Appreciation of content follows from personal characteristics and cultural environment that regulate the long-term commitment to certain aesthetic norms and values which, in turn, guide the appreciation of specific content.
- *Context-of-use.* Appreciation of content might be related to the context-of-use which refers to the real world environment in which the content is experienced. It also comprises the current activities, the intentional purposes, and the mood of the person.

- *Locus of control.* Appreciation of content might be affected by the locus of control that refers to which partner initiates and controls the communications: the user or the system.
- *Programme quality.* Appreciation of content might be affected by the quality of the content presentation (i.e. programme).
- *Memory.* Appreciation of content might vary over time. With respect to establishing appreciation over time, a person might need to accustom to the content, or have to master the required skills and competences for a strategy. The presentation of content might take time to adapt to personal needs and wishes. In contrast, a person might get bored with plain repetitions of the same (sort of) content.
- *Consensus.* Appreciation of content might be coupled with peer group opinions.

1.5.2 Second experiment proposal

The second experiment is a usability study of a multimodal interaction style with speech and gesture input modalities and non-speech audio and graphics output modalities (and musical content for obvious reasons). A device that combines input with tactual force feedback might be also desirable, but introduces to many uncertainties in the project. From a engineering practice, an interaction style can be defined as any combination of three facets: a conceptual operation, an interaction structure, and interaction techniques. A conceptual operation is regarded a low-level user task acted upon a domain object such as annotating, storing, or retrieving content. The interaction structure captures the user-system dialogue in sequences of actions and resolves all kind of miscommunications between user and system (menu structure, command language etc.). The interaction technique describes the employed physical implementation that forms the basis for user-system communication (mouse, keyboard, speech control etc). The interaction style needs to be precisely specified and designed, but will mainly support some typical conceptual operation one might like to exert on the music domain. Consequently, the usability test has to be defined; the interaction style might be compared with a more conventional interaction style such as menu structures.

1.6 Global project description

1.6.1 Global result of the project

The following deliverables are formulated for the year 1997, though they are not formulated in a strictly chronological order. Spin-off projects (e.g., student apprenticeship or graduate projects) will be put on to achieve the project results.

Res1 Demonstrator I for first experiment

This demonstrator supports (and logs data of) the compilation task as stated central in the first experiment (see 1.5.1). Its design and implementation requires relatively little effort.

Res2 Results of first experiment

The results comprises the hypotheses, methods, procedure, data analysis, discussion, and conclusions of the user test.

Res3 Design for a multimodal UIMS

The second experiment requires speech input/recognition, audio output, and gesture input/recognition for which a small-scale user interaction management system (UIMS) must be implemented.

Res4 A small-scale prototype UIMS implementation

A small-scale prototype UIMS will be implemented, and/or contribution to a running effort to implement a multimodal UIMS. It is then expected that this UIMS can be used for the experiments.

Res5 Demonstrator II for second experiment

A demonstrator of a multimodal interaction style will be implemented on top of the UIMS. It mainly supports some user tasks that are subjected to experimentation.

Res6 Results of second experiment

The results comprises the hypotheses, methods, procedure, data analysis, discussion, and conclusions of the user test.

Res7 Concluding article

A concluding article that describes a theoretic framework, the creation process of the demonstrators, and their evaluation.

1.6.2 Global project limits

The following exceptions to the project result are identified.

- No interoperability with platforms or other UIMS systems is guaranteed.
- Only a small-scale UIMS is implemented primarily intended for supporting the demonstrator.
- Aesthetic (graphics) design is not the responsibility of this project.

1.7 Activities

The project schedule deviates from the linear approach of definition, design, and implementation of a deliverable, and the corresponding name-givings. The project is divided into three phases, each has a particular contribution to the list of deliverables.

Phase 1 consists of

- preparing concluding article Res7 by means of working paper;
- designing first experiment for Res2 and implementing demonstrator Res1;
- designing interaction style for Res5 and UIMS Res3;

Phase 2 consists of

- conducting first experiment for Res2;
- implementing UIMS Res4 and interaction style Res5;
- designing first experiment for Res6;

Phase 3 consists of conducting second experiment for Res6 and final project evaluation in Res7.

1.7.1 Activities in Phase 1

The analysis and design phase is focused on the realization of the first demonstrator and the design of the UIMS and interaction style. The following activities are defined for the first demonstrator which will be finished at the end of this phase.

The first three activities are considered continuous activities related to getting a theoretic framework for the research.

Act1 Reading relevant literature.

Act2 Writing several versions of a working paper.

Act3 Communicating and discussing content of working paper with colleagues.

The following activities are defined for the first demonstrator which will be finished at the end of this phase.

Act4 Refining first experimental design and procedure and determining the compilation task.

Act5 Adapting current PATS system to new requirements.

Act6 Designing and generating GUI for first demonstrator (XDesigner).

Act7 Designing and implementing first demonstrator.

Act8 Packaging experiment as a graduate or apprenticeship project.

The next-coming activities are associated with the second demonstrator.

Act9 Surveying existing UIMS-like system

Act10 Designing multimodal interaction style.

Act11 Writing architectural requirements for given multimodal interaction style.

Act12 Communicating/discussing/adjusting architectural requirements.

Act13 Designing UIMS.

With respect to UIMS expertise, the following persons might be consulted within the Philips Research organization:

- Ease-of-Use UIMS-integration (Erik Moll, IT/IST)
- G+4 UIMS implementation (Alex Jansen, IPA/IST)
- Local UIMS-like implementation efforts (Paul Kaufholz, Ercan Gigi, Leon Stuivenberg, IPO/IST)

1.8 Risk analysis

Knowledge transfer and co-operation to other Philips research projects (e.g., WWICE, E-o-U) are necessary. This implies a personal involvement to these projects. If so, concrete measurements have to be taken by (re)-planning and scheduling this project conforming agreements as stated in Section 2.

The project funding is guaranteed until november 1997. A funding from then until november 1998 is only opted. The decision for continuing funding can only be granted by the project owner. The funding decision should be made during the course of this project year. Consequently, any project delay should thus be adequately managed to meet the finishing date as long as there is no agreement on continuing funding. Moreover, the year 1998 will be chiefly assigned to the writing of a PhD thesis for which obviously no funding guarantees are given yet.

It is felt that the implementation of both an indeed small-scale multimodal UIMS and a demonstrator is an ambitious exercise. Any opportunity that might speed up meeting the project objectives must be thoroughly examined, e.g. consultancy of experts at shop floor level, contribution/integration of on-going UIMS implementation projects, or new discovered technology. If co-operation with other projects are established,.dependencies between projects should be monitored to reduce any chance of delay.

The decoupling between the contract partners Philips and Eindhoven University of Technology within the IPO foundation has also effects on the technical infrastructure, technical support, and software licenses at the IPO. Access to Philips WWW services is made impossible for IPO employees which hampers communication with Philips colleagues (e.g., accessing personal pages). The support of platform that has proved to be important for the project (e.g., Silicon Graphics) is no longer guaranteed. Some software licences are strictly Philips-wide and are thus withdrawn from IPO usage (e.g., XDesigner). Other software is Philips-proprietary (e.g., RTA) for which never formal agreements were made, but none the less it is (and will be) used in this project.

2 Project control

2.1 Time

2.1.1 Standard

Starting date Project Agreement Definition started at Monday, 4 November 1996, week 45. The start of the first phase is started at Monday, 3 February 1997, week 6.

Finishing (evaluation) date Friday, 31 October, 1997, week 44.

Capacity One project member (full-time)

Global scheduling of the whole project The project planning is divided into three succeeding phases lasting respectively three, four, and two months (see Figure 2.1). The first two phases deliver the implementation of demonstrators. The third concluding phase is reserved for conducting the second experiment and total project evaluation.

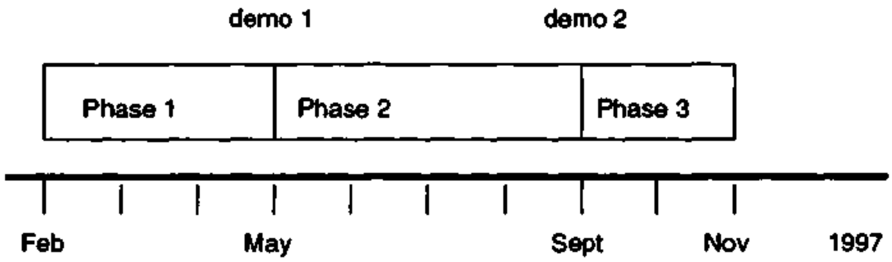

Figure 2.1 Global planning of project.

Detailed activity scheduling of the Phase 1 The proposed schedule of activities are shown in Figure 2.2.

Resources A Silicon Graphics Indy is employed as environment which is already available. Additionally, a SUN sparc-5 workstation is primarily used as server for storing the personal music collection.

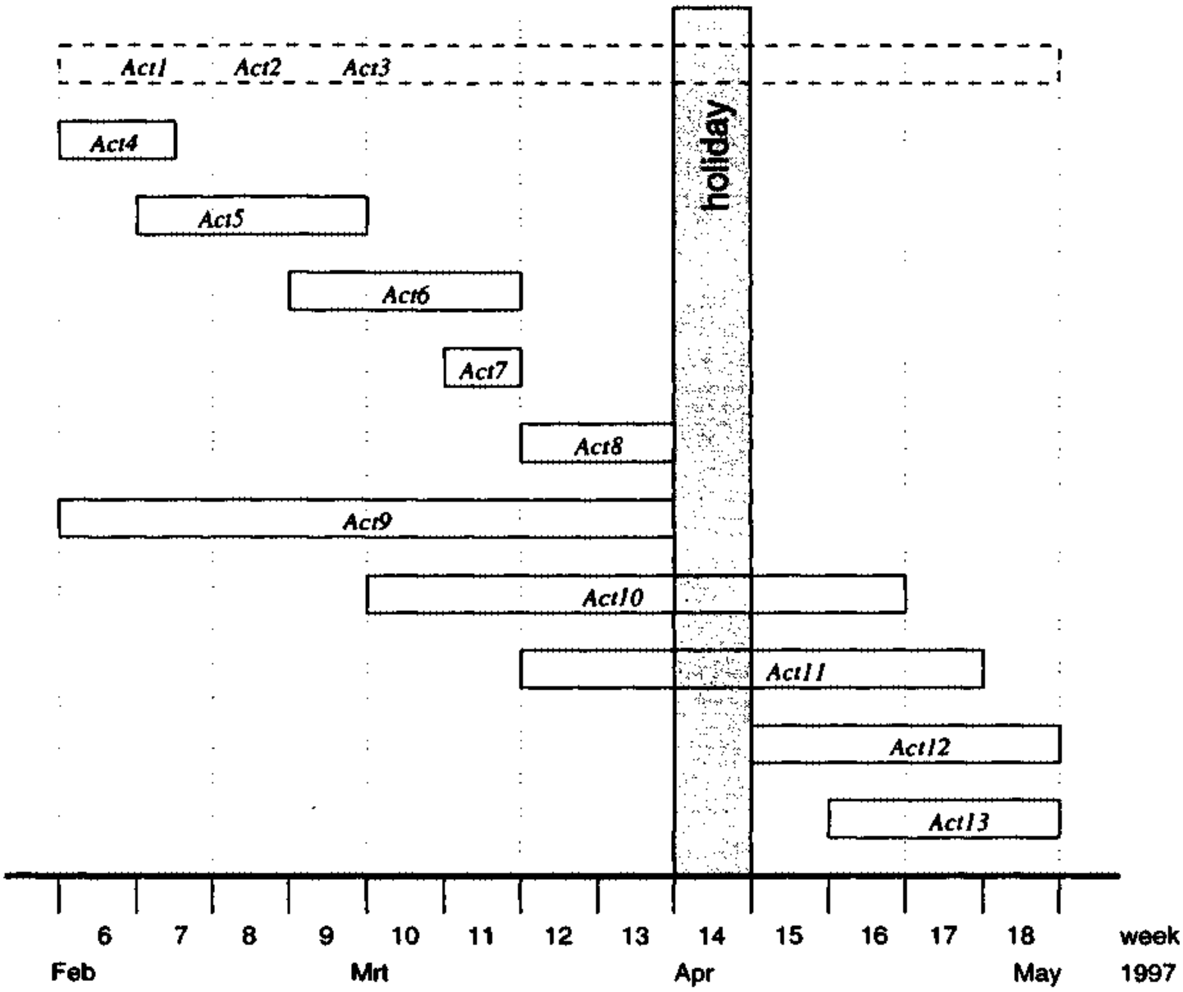

Figure 2.2 Detailed planning of Phase 1.

2.1.2 Control

Weekly meeting with programme coordinator to discuss more organizational and project control aspects of the project. (By default, Monday, 11:00-12:00).

Weekly meeting with first promoter to discuss more theoretical aspects of the project. (By default, Wednesday, 13:30-14:30).

Monthly meeting with both programme coordinator and first promoter to discuss overall project progress. (By appointment)

Monthly progress reporting to project owner that presents:

- results of reporting and last period, results expected in next month
- issues related to problems, risks, and new opportunities
- deviations from planning
- external contacts

2.2 Money

At the IPO, budgets are delegated to each individual thematic leader. As a consequence, the thematic leader of the 'Multimodal Interaction' theme is responsible for the financial control for all projects within that theme and, hence, also for the 'Adaptive Multimodal Interaction' project. This includes the finance concerning the resources required during the project. Travelling expenses are budgeted by the same thematic leader.

The project funding to finance the capacity of one project member is controlled by the project owner on the basis of a contract between IST/IT and the Technical University of Eindhoven. It is only guaranteed until november 1997. A continuing funding until november 1998 is only opted. The decision for continuing funding should be made during the course of this project year.

2.3 Information

Documentation standard All documents adopt the style and structure as considered 'de facto' within Institute for Perception Research (IPO), but already standardized by the Information Technology (IT) group of the Information and Software Technology (IST) sector of Philips Research Laboratories Eindhoven (PRLE).

Version control Project information and software will be maintained in a project database.

Information Distribution Documents will be distributed to the project owner, supervisors, advisors, and programme coordinators at the IPO.

2.4 Organization

Project member The project leader is responsible for achieving the project results (the present author). Both the project content, planning, and any re-planning should be in accordance with the project owner, the thematic leader, and the first promoter. Agreements should be established at formal reviews. A board of advisors (experts) provide important input for the project content. Changes to deliverables, content, and planning can only be executed when an agreement has been achieved by the project leader, project owner, thematic leader, and the first promoter.

Programme coordinator The programme coordinator is dr. ir. J.H.(Berry) Eggen (Institute for Perception Research) and is concerned with the managerial supervision of the project member.

Project owner The project owner is dr. M. (Menno) Treffers, group leader at Information and Software Technology (IST).

First promoter Prof. dr. D.H.G. (Don) Bouwhuis (Institute for Perception Research) is concerned with the theoretic content supervision of the project.

Advisors The task of an expert is consultancy by providing relevant project content input. The experts with their prime field of expertise are listed below:

- Dr. P.(Peter) Wavish (Philips Research Laboratories, Redhill) and is concerned with more technical support (e.g. usage of RTA).

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