05181 Abstracts Collection
Mobile Computing and Ambient Intelligence: The Challenge of Multimedia
— Dagstuhl Seminar —

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Abstract. From 01.05.05 to 04.05.05, the Dagstuhl Seminar 05181 "Mobile Computing and Ambient Intelligence: The Challenge of Multimedia" was held in the International Conference and Research Center (IBFI), Schloss Dagstuhl. During the seminar, several participants presented their current research, and ongoing work and open problems were discussed. Abstracts of the presentations given during the seminar as well as abstracts of seminar results and ideas are put together in this paper. The first section describes the seminar topics and goals in general. Links to extended abstracts or full papers are provided, if available.

Keywords. Mobile computing, ambient intelligence, multimedia

05181 Preface – Mobile Computing and Ambient Intelligence: The Challenge of Multimedia

Pavel Slavik (Czech Technical University, CZ)

Mobile computing gains in last years an increasing importance. It penetrates into new areas of everyday life. With increasing computing power that is available in recently developed mobile devices the mobile computing approach is used in new areas (where its use would not be possible few years ago). Due to specific properties of mobile devices the traditional approaches to the traditional schemes for communication between users and the devices are not applicable. Another important issue that is linked with new applications in the field of mobile computing is derived from the fact that portable information appliances are pervading the everyday life and ambient intelligence is starting to surround us. Adapting multimedia applications and services to these delivery environments

and enabling ensembles of multimedia appliances to organize themselves spontaneously and ad hoc will be major technical issues that have to be solved in near future. These problems were discussed during the Dagstuhl Seminar 05181 that took place in Schloss Dagstuhl from 01.05.05 to 04.05.05.

Keywords: Mobile computing, ambient intelligence, multimedia

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2005/380

A Reference Architecture for Mobile Knowledge Management

Dirk Balfanz (ZGDV e. V. – Darmstadt, D)

Although mobile knowledge management (mKM) is being perceived as an emerging R&D field, its concepts and approaches are not well-settled, as opposed to the general field of Knowledge Management (KM). In this work, we try to establish a definition for mKM. Taking into account building blocks of KM in enterprises and the abstract use cases of mKM systems we introduce an reference architecture for mKM systems as a basis for verifying and comparing concepts and system architectures. Finally we address the potential of mKM to be suitable as a prototype model for mobile, situation-aware information processing in the field of Ambient Intelligence Environments.

Keywords: Knowledge Management, Mobile Computing, Context-Awareness, Ambient Intelligence

Joint work of: Balfanz, Dirk; Grimm, Matthias; Tazari, Mohammad-Reza

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/374

Adaptation of Learning Spaces: Supporting Ubiquitous Learning in Higher Distance Education

Birgit Bomsdorf (FernUniversität Hagen, D)

Ubiquitous learning is supported by ubiquitous computing and represents the next step in the field of e-learning. The goal is, that learning environments will be accessed increasingly in various contexts and situations. From this challenge, new questions arise concerning the adaptation of learning spaces to different contexts of use, so that they continue to enable and support learning processes. As a basic work in this direction, this paper introduces a first notion of a comprehensive definition of "plasticity of digital learning spaces". It exem-plifies some of the facets affecting the plasticity and presents aspects of a first system prototype, which enables to select learning materials depending on a given situation.

Keywords: Ubiquitous Learning, Adaptation, e-Learning

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/371

Interaction with Ubiquitous Computers and Media

Andreas Butz (Universität München, D)

In this talk I will introduce instrumented environments as an example scenario for the investigation of interaction techniques and concepts for ubiquitous computing. We will see how the topic of interaction can be approached at different levels and I will give an overview of some recent results from my research group Fluidum (http://www.fluidum.org/).

At the seminar, I would like to discuss other people's approaches to interaction on a conceptual level, and how they hope to find generalizable interaction schemes.

Keywords: Interaction, user interfaces, instrumented environments, UI metaphors, tangible UIs, physical UIs

Towards an Integrated Development Environment for Context-Aware User Interfaces

Tim Clerckx (University of Limburg, B)

The emergence of mobile computing devices brings along the fact that users interact with computers in various environments. The user interface of a mobile system can be affected by environmental context. Several approaches succeed in providing architectures and frameworks to support the building and reuse of software components considering context information. Taking into account context information in designing the interaction of a system, however, has not yet been extensively investigated. In this paper we will discuss an Integrated Development Environment, DynaMo-AID, we are developing to support the design, prototyping, evaluation and deployment of context-aware interactive systems.

Keywords: Model-based user interface design, context-aware user interfaces

Joint work of: Clerckx, Tim; Coninx, Karin

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/369

Advanced Multi-Modal User Interfaces – Visualisation, Natural Language and Platform Independence

Peter Forbrig (Universität Rostock, D)

The talk presents a strategy of developing interactive systems, which is a combination of using results from visualisation, natural language processing and model-based design. It shows that extended task models can be used to specify information for visualisation and natural language processing. Additionally, the transformation from analysis models to navigation and presentation models is demonstrated. XML-Technology is used to combine different specifications for the user interface.

Keywords: Model-Based Design, Multiple-User Interface, GUI Editor, XUL, Eclipse

Visualization in Multimodal User Interfaces of Mobile Applications

Georg Fuchs (Universität Rostock, D)

Advanced user interfaces are a crucial factor in the success of mobile information systems employed by different users on a variety of devices. They should provide state-of-the-art visualization and interaction techniques taylored for specific tasks, while at the same time allow flexible deployment of these components on a multitude of (mobile) hardware platforms. Especially visualizations have to adapt to the platform capabilities in order to remain not only effective, but also adequate.

Focus & Context techniques are one way to efficiently make use of displays with low resolution and size, as are lens techniques. Here, a good tradeoff between complexity and response time is important. Also, complex inputs are not feasible on most mobile devices. Simple, straightforward, context-driven interaction options must be presented to a user. The above can be archieved by integrating a task model, user (role) and resource models as well as multimodal interaction facilities such as speech recognition, into the user interface component of mobile information systems. The talk will report on research on the above aspects within the M6C project.

Keywords: Visualization, Multimodal User Interfaces, Mobile Devices

Joint work of: Fuchs, Georg; Schumann, Heidrun

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/367

Smart Environments and Self-Organizing Appliance Ensembles

Thomas Heider (Universität Rostock, D)

The vision of Ambient Intelligence is based on the ubiquity of information technology, the presence of computation, communication, and sensorial capabilities in an unlimited abundance of everyday appliances and environments.

It is now a significant challenge to let ambient intelligence effortlessly emerge from the devices that surround the user in his environment. Future ambient intelligent infrastructures must be able to configure themselves from the available components in order to be effective in the real world. They require software technologies that enable ad-hoc ensembles of devices to spontaneously form a coherent group of cooperating components. This is specifically a challenge, if the individual components are heterogeneous in nature and have to engage in complex activity sequences in order to achieve a user goal. Typical examples of such ensembles are smart environments.

It will be argued that enabling an ensemble of devices to spontaneously act and cooperate coherently requires software technologies that support unsupervised spontaneous cooperation. We will illustrate why a goal based approach is reasonable and how explicit goals can be used to find system comprehensive strategies and how explicit declarative goals could be used as a benchmark to evaluate the system design.

Keywords: Dynamic Service Composition, Strategy Planning, Resource Optimization, Ambient Intelligence

Joint work of: Heider, Thomas; Kirste, Thomas

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/375

Distributed Implementation of a Self-Organizing Decentralized Multimedia Appliance Middleware

Michael Hellenschmidt (Fraunhofer Institut – Darmstadt, D)

A middleware for real ad-hoc cooperation of distributed device ensembles must support self-organization of its components. Self-organization means that the independence of the ensembles' components is ensured, that the ensemble is dynamically extensible by new components and that real distributed implementation is possible. Furthermore the data-flow of messages within the ensemble may not be statically determined. This article presents the application of the SodaPop model for distributed device ensembles to physical heterogeneous devices as well as the distributed implementation of conflict resolution strategies that guarantee the data-flow even if there are competing components. The proposed approach relies on the principle of device representatives.

Keywords: Self-organizing middleware, conflict resolution mechanisms, distributed implementation

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/378

Smart Environments and Self-Organizing Appliance Ensembles

Thomas Kirste (Universität Rostock, D)

The vision of Ambient Intelligence (AmI) is based on the ubiquity of information technology, the presence of computation, communication, and sensorial capabilities in an unlimited abundance of everyday appliances and environments.

It is now a significant challenge to let ambient intelligence effortlessly emerge from the devices that surround the user in his environment. Future ambient intelligent infrastructures must be able to configure themselves from the available components in order to be effective in the real world. They require software technologies that enable ad-hoc ensembles of devices to spontaneously form a coherent group of cooperating components. This is specifically a challenge, if the individual components are heterogeneous in nature and have to engage in complex activity sequences in order to achieve a user goal. Typical examples of such ensembles are smart environments.

Today, the interaction between the components of these environments his handcrafted; substantial changes in ensemble composition require a manual adaptation of the controlling software infrastructure. Tomorrow, such smart ensembles have to be able to organize themselves from components built by different vendors.

Today, self-organizing sensor networks are investigated – a repetitive texture formed by components without significant individuality, and with a sharply defined application domain for the overall network. Tomorrow, component networks have to be considered where each member is able to provide a significant and individual contribution to the overall ensemble functionality, situated in a loosely defined and expanding application domain – such as the "smart home". The concept of self-organization will need to attain a new level of awareness of the application domain underlying the ensemble's activities, as well as a certain consciousness regarding the capabilities of the ensemble member's and their effective deployment within a complex joint activity.

It will be argued that enabling an ensemble of devices to spontaneously act and cooperate coherently requires software technologies that support self-organization. We will discuss the central issues pertaining to the self-organization of interactive appliance ensembles and outline potential solution paradigms: Goal-based interaction and distributed event processing pipelines.

Keywords: Smart Environments, Self-Organization, Ambient Intelligence

Joint work of: Heider, Thomas; Kirste, Thomas

Context-sensitive User Interfaces for Ambient Environments: Design, Development and Deployment

Kris Luyten (University of Limburg, B)

There is a growing demand for design support to create interactive systems that are deployed in ambient intelligent environments. Unlike traditional interactive systems, the wide diversity of situations these type of user interfaces need to work in require tool-support that is close to the environment of the end-user on the one hand and provide a smooth integration with the application logic on the other hand. This paper shows how the Model-Based User Interface Development methodology can be applied for ambient intelligent environments; we propose a task-centered approach towards the design of interactive systems by means of appropriate visualizations and simulations of different models.

Besides the use of typical user interface models, such as the task and presentation model, we focus on user interfaces supporting situated task distributions and a visualization of context influences on deployed user interfaces. To enable this we introduce an environment model describing the device configuration at particular moment in time. To support the user interface designer while creating these complex interfaces for ambient intelligent environments, we discuss tool support using a visualization of the environment together with simulations of the user interface configurations. We also show how the concepts presented in the paper can be integrated within Model-Driven Engineering, hereby narrowing the gap between HCI design and software engineering.

Keywords: Model-Based User Interface Development, Model-Driven Engineering, Task-centered Interface Design

Joint work of: Luyten, Kris; Vandervelpen, Chris; Van den Bergh, Jan; Coninx, Karin

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/377

Interaction with Mobile Devices – Semantics and Context

Rainer Malaka (Europ. Media Lab. – Heidelberg, D)

The challenge of ubiquitous computing is not just access to data on all possible locations. It rather aims at providing intelligent services in all situations. Thus, intelligent systems should know about a user's location, the situation and services in order to provide most useful information in a given context. This perspective goes well beyond networking questions because systems must have and use knowledge about context and data. The Semantic Web is one attempt to enrich IT systems with semantics and to allow for more intelligent services. This can be combined with Ubiquitous Computing for building smart assistants that know about the user's context and can, for instance, answer to questions

like "How big is mount Fuji" with an altitude (3776 meters) rather than with a selection of links to Web sites. The talk will present some present research work of EML on rich semantic services for mobile users. In these projects various techniques ranging from resource-adaptive middleware to semantic analysis of texts are combined in order to allow for ubiquitous knowledge access.

Keywords: Mobile devices, semantics, semantic web

Ontology driven voice-based interaction in mobile environment

Zdenek Mikovec (Czech Technical University, CZ)

The paper deals with a new approach for spoken dialogue handling in mobile environment. The goal of our project is to allow the user to retrieve information from a knowledge base defined by ontology, using speech in a mobile environment. This environment has specific features that should be taken into account when the speech recognition and synthesis is performed. First of all, it limits the size of the language that can be understood by speech recognizers. On the other hand, it allows us to use information about user context. Our approach is to use the knowledge and user context to allow the user to speak freely to the system.

Our research has been performed in the framework of an EU funded project MUMMY. This project is targeted to the use of mobile devices on building sites. This fact determines the approach to the solution of the problem. The main issue is user context in which the interaction takes place. As the application (construction site) is rather specific it is possible to use the knowledge related to this particular application during the speech recognition process.

Up-to now the voice based user interfaces are based on various techniques that usually contain various constraints which limit the communication context to strictly predefined application domain. The main idea behind our solution is usage of ontology that represents the knowledge related to our particular application in specific user context. The knowledge acquired from ontology allows the user to communicate in mobile environment as the user input analysis is heavily simplified. The crucial step in our solution was the design of proper system architecture that allows the system to access the knowledge in ontology and use it to enhance the recognition process.

The model of environment in which the recognition process is performed has several parts:

- domain ontology (construction sites in general)
- instance of the domain ontology (specific construction site)
- conversation history
- specific user context (location, type of mobile device etc.).

The key part of the model is the access mechanism that allows to extract particular knowledge in specific context. This access mechanism is controlled by

means of dialogue automaton that controls the course of dialogue. The acquired knowledge is used in the speech recognizer for generation of a specific grammar that defines the possible speech inputs in a particular moment of the dialogue – in the next state another access into ontology in different context is done resulting in generation of a grammar that defines new possible inputs. The same access mechanism is also used to produce a response to user's input in natural language.

There exists a pilot implementation of the voice based user interface system, which has been tested in various situations and the results obtained are very encouraging.

Keywords: Ontology, voice user interfaces, mobile environment

Joint work of: Kopsa, Jiri; Mikovec, Zdenek; Slavik, Pavel

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/376

Model-based User Interface Adaptation

Erik G. Nilsson (SINTEF – Oslo, N)

Most work on model-based cross-platform user interface development is based on an assumption that the user interfaces on the different platforms should be as similar as possible. Much work on mobile user interfaces claim the opposite – that user interfaces on a mobile platform should have features not applicable on a stationary one and vise versa. Exploiting contextual information in user interfaces on mobile equipment is a prime example of this. This paper focus on this dichotomy between common development and exploiting platform specific features (or having specialized versions) on each platform. Few or none of the existing model-based languages and tools for user interface development are able to combine these two needs. These aspects are initially very difficult to combine, but in the paper we present an approach that makes this possible. First we briefly present our modelling approach, we pinpoint some of the general differences between mobile and stationary user interfaces, and we present an approach to building such self adapting systems where the adaptation is handled by generic middleware. Our approach builds on component frameworks and variability engineering to achieve adaptable systems, and property modelling, architectural reflection and context monitoring to support dynamic self-adaptation. With this as a background we investigate how the presented modelling approach may be extended and combined with the adaptive architecture to facilitate model-based user interface adaptation. Finally, we present some more general prinňciples for how model-based approaches may be used when developing adaptive user interfaces.

Keywords: Model-based interface design, personalization and customization of interfaces, patterns-based approaches, adaptive architecture

Joint work of: Nilsson, Erik G.; Floch, Jacqueline; Hallsteinsen, Svein; Stav, Erlend

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/372

Interactive TV meets Mobile Computing

Uwe Rauschenbach (Siemens – München, D)

The talk presents some recent developments in interactive digital television and discusses the trends and challenges of bringing TV services to mobile devices. Two areas will be addressed: portable use of mobile devices to complement the TV set in the home and mobile TV services while on the move using mobile broadcasting technology.

Keywords: Mobile interactive television, DVB-H

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/368

Multiple-User Interfaces based on Task, User and Object Models

Daniel Reichart (Universität Rostock, D)

Developing and maintaining user interfaces for many different devices is a complex task. We propose a model-based approach that combines task, object and dialog models to specify platform-independent user interfaces. The introduction of new concepts like instance iteration for tasks or relating tasks to domain objects and dialog views allows us to generate abstract canonical prototypes running on several devices. Finally, this talk gives an example of how to build and refine a specific user interface for the PocketPC-platform from our models.

Keywords: User interfaces, dialogue models

Joint work of: Reichart, Daniel; Forbrig, Peter

Structured Audio Information Retrieval System

Dirk Schnelle (TU Darmstadt, D)

The Structured Audio Information Retrieval System (STAIRS) project targets environments where workers need access to information, but cannot use traditional hands-and-eyes devices, such as a PDA. The information to be accessed is stored in an information base, either as pre-recorded audio or as text to be run through a text-to-speech engine. Given the inherent limitations of the simple audio interface used in STAIRS, it is important to structure the information base in a way which makes navigation as easy as possible for the user.

Keywords: STAIRS, mobile worker, hands and eyes free, audio, Voice user Interface

Joint work of: Schnelle, Dirk; James, Frankie

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/370

Object based manipulation with 3D scenes in mobile environment

Pavel Slavik (Czech Technical University, CZ)

The increasing power and display resolution of mobile devices allow the user nowadays to work with 3D information in mobile environment. The use of this new technology brings some new problems that need an urgent solution. One of them has its roots in the fact that common users are not trained to work in 3D graphical environment in general. The main obstacle for a common user is the fact that 3D environment offers too much freedom for object manipulation in comparison with situation in 2D environment.

There are various solutions to this problem but usually they do not handle efficiently the problem of navigation in 3D environment in context of handling appropriate information density on a small screen on a mobile device. Our approach is based on transformation of a 3D scene in 2D representation in order to decrease freedom of movement during navigation in the scene. The navigation (and other types of interaction) is performed in 2D environment – the information acquired during interaction is transformed back into 3D form (into 3D object space). In such a way the user can manipulate single objects in various modes (e.g. the user can change focus on various objects what might e.g. result in their temporary elimination from the scene).

The work in 2D in mobile environment requires some special features that are not considered in standard environment. Especially critical is zooming. Zooming in raster form could change the picture on a small screen into completely unusable representation (pixels will be transformed in tiles that will be difficult to perceive). Solution to this (and to other related problems) is the use of SVG format to handle 2D scene representation. The main advantage of SVG is that it is object oriented and supports zooming, interaction with objects, scene annotation and manipulations with objects. The process of scene transformation and manipulation with objects is distributed between the server and mobile device. The transformation is performed on the server side. The resulting 2D representation of the scene is sent to mobile device where the visualization is performed. The user can interact with the picture on the mobile device with interaction techniques available on mobile devices.

As the SVG is XML based format, the Cascading Style Sheets can be used to style all graphical elements. Therefore each object can be visualized in different mode (solid, transparent, semitransparent). These modes could be changed interactively. This feature (interactive change of modes) substitute in certain sense

some functions available for avatars during their walkthroughs when performed in standard 3D environment (e.g. "having look behind corner" etc.). The user interaction in 2D environment is rather limited in comparison with standard 3D interaction but it is less demanding for the user. On the other hand it brings better picture quality due to SVG features applied e.g. during the process of zooming.

Keywords: Mobile computing, 3D, rendering

Joint work of: Slavik, Pavel; Cmolik, Ladislav; Mikovec, Zdenek

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/373

Multimedia Literacy: The Human Perspective and Adaptation Management

Christian Stary (Johannes Kepler Univ. – Linz, A)

Considering multimedia application in various domains, adaptation seems to be a crucial asset to provide multi-user, multi-device or multiple role access to information and interaction features. So far, adaptation has rarely been investigated as a construct that is related to several usability parameters or measurements. We report on some findings leading to a more comprehensive understanding of adaptation.

Keywords: Adaptation, multimedia user interfaces, suitability for individualization

Connecting the Vehicle with the Environment – Trends and Challenges

Gerrit de Boer (Robert Bosch GmbH – Hildesheim, D)

Innovations in automotive electronics have become increasingly complex, resulting in high-end vehicles containing more than 70 electronic control units and offering a variety of functions to the driver. In-vehicle telematics and infotainment systems provide services like digital radio, broadcast services, television, and MP3 audio. Future applications and services will integrate information sources available outside and inside the car, requiring vehicle systems connected with in-vehicle Consumer Electronics devices and the outside world. The talk will address possible future scenarios including the requirements and challenges of future vehicle infotainment and telematics systems.

Keywords: Infotainment, Telematics, Vehicles, Connectivity

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2005/379