
The HTI Lab @ ftw: User Research for Telecom Systems

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Abstract

This paper presents the Human-Telecom Systems Interaction Laboratory (HTI lab) at the Telecommunications Research Center Vienna (FTW). The current setup of the HTI Lab and its contributions to related application-oriented projects at ftw are described.

Keywords

Human-computer interaction, user-centered design, mobile devices, quality of experience (QoE)

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Reshaping Telecommunications Research

In recent years, research in telecommunications has achieved dramatic advances, but it is also constantly facing new challenges. The Telecommunications Research Center Vienna (www.ftw.at) is at the edge of these developments. Founded in 1999 in the framework of the Austrian government's Kplus competence center program, FTW aims at fostering the innovation potential of its partners from telecommunications industry and research. FTW bridges the gap between basic and industrial research by bringing together experts from our academic and industrial partners in concrete projects of joint interest (see fig. 1). Approximately half of



figure 1. FTW bridging the gap between basic and industrial research.

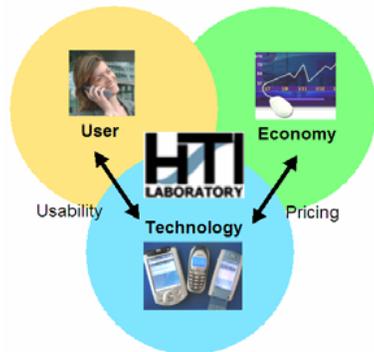


figure 2. The HTI lab complements technological competencies with economic and user aspects of telecommunications research.

our funding comes from the Austrian government and the other half from telecommunications companies.

Initially, FTW's research program had a strong focus on wireless and wireline data transfer as well as core networking aspects. With the advent of broadband solutions like UMTS or xDSL, further topics of high relevance for the competitiveness of FTW's partners have emerged, many of them closely related to questions of user acceptance and economic value:

- Once the data transmission infrastructure has been set up and is operating efficiently, it becomes crucial to "make use" of this technology, i.e. to find added-user benefit and compelling application ideas.
- Immature mobile interaction concepts, most prominently WAP, have resulted in disappointing commercial revenues. This together with emerging interaction possibilities, such as speech and multimodality, has significantly increased the awareness for the need for more careful user-centered development of new applications.
- In an increasingly competitive market, service differentiation is of growing interest. But Quality-of-Service (QoS) has its price. In the future it will be especially important to link charges to the service quality as perceived by the user, i.e. the "Quality-of-Experience" (QoE).

In order to react to the fact that telecommunications research has grown far beyond pure communications engineering and today covers the entire economic value chain up to the end customer, in 2003 FTW set up a strategic research activity. The Human Telecom Sys-

tems Interaction Laboratory (HTI lab)" was initiated as an integral part of this activity.

The distinctive attribute of the HTI lab is the complementation of core-competencies in technology by user-related (HCI, QoE) and economic (billing/charging) topics with a dedicated focus on telecommunications research (see fig. 2). Although somewhat comparable in thematic scope to the established Human Factors in Telecommunications symposia [8], the HTI lab is the first to incorporate this important area systematically in an applied research center. In the HTI lab, an interdisciplinary team of 15 researchers from diverse backgrounds work together e.g. HCI, engineering, mathematics, multimedia, psychology, economics, and marketing.

Research in the HTI Lab

In this section we describe the specific research topics we have focused on in the last two years since starting the HTI lab. First we outline the research contributions of two projects related to mobile HCI, multimodality and auditory interaction design. We then briefly demonstrate ongoing investigation into new iTV application concepts. Finally, we present contributions related to QoE, namely pricing mechanisms and perceptual speech quality measurements. It should be remembered that due to FTW's funding method and organizational principles, the selection of research projects highly depends on the interests of our partners from academia and industry.



figure 4. “Acting out” in a user requirements gathering sessions (top), lab usability testing of a multimodal application (middle) and evaluating multimodality in the field (bottom).

Designing multimodal applications

Current 3G technology poses challenges to researchers and application designers who are trying to build mobile multimedia applications for business and entertainment usage e.g. tiny displays and keypads, the context of use, and information retrieval on the fly. To investigate the potential benefits of multimodal interfaces in mobile contexts in this regard, several applications have been developed: a map-guide, a messaging client and a quiz game. The process we followed is outlined in fig. 3. The aim was to have a high level of user involvement throughout the whole development process (we call this approach “design through dialogue”, see [1] for further details).

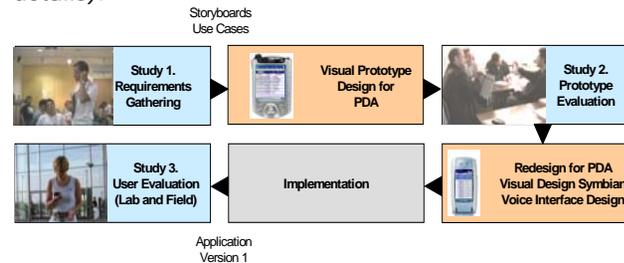


figure 3. Multimodal development process [1]

In addition to strong user involvement throughout the design process, we provided the first comparative results based on a combined lab and field test of multimodal systems (see fig. 4), investigating whether users have a different experience and use different modalities in both contexts [1].

Design guidelines for speech-enabled interaction

We also aim at providing our partners and the developer community with generic empirical design guidance. Controlled experiments enabled us to derive

guidelines for the suitability of non-speech sound and paralinguistic parameters in interactive speech applications [4] and for the design of mobile speech synthesis architectures [7].

Exploring new iTV application concepts

In the HTI lab, we also investigate wider issues than classic usability research. For example, we are looking into the emerging Social TV concept and its impact on related phenomena, such as the “joint TV experience”, social presence, or the notorious “lean backwards” attitude of TV-watchers [5, 2]. The reason for this work is that currently there is a move to combine telecommunications and IT to enable a broad range of new home entertainment services such as interactive television applications in the context of “triple play”, i.e. the bundled provision of TV, voice telephony and broadband access. However, a prerequisite to widespread adoption and commercial success is to make sure that these new applications and services are usable, useful and used by the end customer.

Quality of Experience (QoE) and user-friendly pricing

The user’s willingness-to-pay for a telecom service depends strongly on their Quality-of-Experience (QoE). Measurements in the HTI Lab are helpful to quantitatively derive economic utility functions, which in turn serve as primary input to efficient pricing mechanisms like second-price auctions for service delivery [10].

Transparency and user-friendliness are further key criteria for the design of pricing mechanisms [11]. . Here, the HTI Lab offers the unique opportunity to combine application-oriented user tests, e.g. on perceptual quality of Voice-over-IP (VoIP), with evaluations concerning the user acceptance of novel charging schemes.

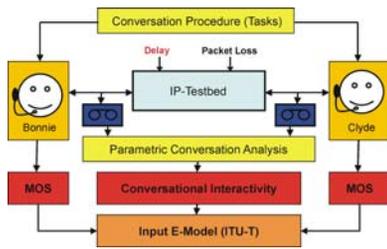


figure 5. Test Setup for Perceptual Quality Measurements. The test persons are given tasks which they fulfill in calls using connections at different transmission conditions. After each call, the subjects rate the perceived quality. The resulting conversations are recorded and analyzed. The results served as an input for the current transmission planning model (E-Model, ITU-T Rec. G.107).

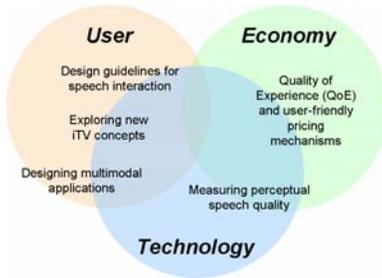


figure 6. Summary overview of HTI lab research activities 2003 – 2005.

Measuring perceptual speech quality

Generally speaking, VoIP technology poses important new challenges for QoE research, such as transmission delay in two-way communication. Regarding the user perception, the impact of delay on the conversational speech quality is not yet completely understood.

In the HTI Lab, we carry out conversational speech quality tests investigating the relationship between the conversational structure/interactivity, transmission delay and perceived quality. We study the impact of delay using a variety of different test tasks and apply our method of parametric conversation analysis (PCA, [7, 9], the test-setup is illustrated in Fig. 5).

Conclusions and Outlook

After roughly two years of operational deployment, the HTI Lab has already had a significant impact on FTW's research agenda, and user-related topics have become an integral part of many cross-disciplinary application-oriented projects. The high quality of the conducted studies is appreciated by our industry partners, thus demonstrating that the idea of gradually extending an established strong technical competence towards user and economic aspects is a feasible, useful and profitable concept. An important future direction of the HTI lab is to continue with the conceptualization of an integrated HTI research framework, e.g. achieving closer connections between QoE and HCI. Finally, we further aim at building on and advancing our participatory and field-based methods [1, 2, 3] to deal with both the mobility and the ubiquity of future telecom applications.

Acknowledgements

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