Video-Based Demonstration:
Hands-Free / Eyes-Free Support for Mobile Workers

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Categories and Subject Descriptors:

J.9.d [Mobile Applications]: Pervasive computing; J.9.e [Mobile Applications]: Wearable computers and body area networks; H.5.2.a [Information Interfaces and Representation (HCI)]: Auditory (non-speech) feedback

Research area:

One of the focus areas of our ubiquitous computing research is context aware support for people on the move, in particular for mobile workers who need hands and eyes free. "Mobile" here refers to everything except "sitting at a PC": it includes, e.g., workers at assembly lines or in laboratories.

In order to understand our focus, one may imagine an employee carrying out a manual activity as part of her job description; further, one has to imagine an environment equipped with smart items (tags, sensors, …). Based on process models, enterprise integration software, and the context awareness provided, applications can i) "understand" the employees' tasks, actions, and needs; and ii) deliver appropriate information / instructions to their local device. As such an application can probably never foresee the needs of the user with 100% accuracy, a mixed initiative approach is desirable, where the user can at any time access arbitrary pertinent information in a kind of "audio browsing" mode, see below. In fact, our prototypes put the users in control of the interface as much as possible. Our studies have shown that audio support would be the preferred solution over the often-cited augmented reality, head-mounted display based support, for many application areas today.

Research results to be demonstrated:

As part of this research, we have developed a solution consisting of the following:

1. *TAs (Talking Assistants):* ubiquitous interaction devices to be carried by the mobile users; TAs can act autonomously, but usually provide their services in cooperation with the IT environment; all TA prototypes built so far consist of
    o CPU and memory
    o an audio based UI, speech recognition capabilities
    o Stairs support (see below)
    o wireless networking capabilities (in present prototypes: WiFi)
    o location awareness via absolute or relative positioning (i.e., a positioning system – typically a LPS - or sensors for tags & badges in the surroundings)
    o optional head movement / orientation detection
    o *digital identity* management / support
    o Scalability support for up to hundreds of devices in a hall size area

2. *Stairs (structured audio information retrieval),* a software and innovative approach to navigation and browsing in structured audio documents (think of an "audio equivalent of a Web Browser", usable for online manuals and much more). In sharp contrast to usual voice applications (VoiceXML based or else), Stairs is consistently based on the same standard set of navigation commands in all navigational situations, such that mobile workers can get easily trained to use it. Our stairs research has also led to the support of document structures ("sitemaps", in Web terminology) that can be handled by the short term memory of mobile audio-only users (who have to deal with shared attention and lack of visual clues). With Stairs, the delivery of context-sensitive information and instructions can be mixed with user-controlled navigation through audio documents, in accordance with the requirement stated in the beginning.

3. *MundoCore,* a distributed development environment with ubiquitous middleware, support for 2D and 3D world models, distributed debugging, a unified distributed programming paradigm (for Java and C), support for vertical migration from large to very small footprint nodes, and more.

4. *IRIS,* a set of IR-based solutions to both absolute and relative positioning.

Video Demonstration:

We have studied one of the three large application areas of TAs in the automotive field: i) factory floor (car manufacturing), ii) driver/passenger support, and iii) supervisor & technician support at service stations / carshops. The results of the third study were combined into a running demo of Stairs enabled TAs, showing their use by several employees during the process of automotive maintenance, from customer arrival through pick-up of the repaired car. The demo was built using the above-mentioned distributed development environment; it demonstrates TAs, Stairs, and the Stairs navigations structure as used in the demo application; while the MundoCore is used but not visible, IRIS tags and badges are demonstrated in cooperation with the TA.

Talking Assistant, above,
Tags/Badges (outside, inside), below

This demo application has been canned as a video; (note that the video demo goes slightly beyond the actual realization in that it includes two little fake examples of natural language understanding for better illustration of a potential full integration with an enterprise information system; in reality, this part requires better embedded voice processing hardware than the one built into the prototype).