Enabling adaptive multimodal interfaces

Reducing complex user-interface design cost using a model-based approach

EMODE showed that it is possible to manage multimodal interaction for complex business systems at low cost. Following a model-based design approach, EMODE demonstrated performances three to four times superior to the usual productivity, maintenance and evolution ones thanks to an automation of the development. In case of porting, only specific code has to be redeveloped. EMODE also proved that such sorts of devices and modalities are profitable. Gains are in terms of efficiency, effectiveness and satisfaction. Furthermore, models used for design are reused to manage the interaction, ensuring coherence between user requirements, designers’ developments and final interaction.

State-of-the-art adaptive multimodal interfaces providing the user with new means of interaction, such as voice or gesture, and dynamically adapting to user needs, have not yet reached the professional market. User interfaces (UIs) are designed and computed once and for all without any provision for adaptation at runtime. As a result, UIs remains the weak point of many systems, the problem of human-computer interaction not being considered as a central issue regarding the design and development of complex systems.

We use many different devices everyday – telephones, smart phones, personal digital assistants (PDA), touch screens, personal computers (PCs) with webcams and microphones. We interact with these devices using classical Windows icon menu pointers (WIMPs), gesture recognition such as with PDAs or vocal-command systems – for example voice mail or call menus. We use them at home or in large public application such as information systems.

More restrictions in business

On the other hand, UIs for complex business system are far more restricted. The classical WIMP interaction remains the standard even if it leads to non-natural or long sequences of interactions to access to some functionalities. In the worst cases, operators suffer from a cognitive overload in critical situations: too much information, too many actions to perform or no way to access additional information without losing the context.

Industrial systems providers argue that introducing such modalities and adaptability functionalities are too costly with respect to benefits, usability and reusability or global return on investment (RoI).
example, a grammar for voice-recognition and command systems is about 10 Mb of text. Such an investment is huge for a system and even worse if it cannot be adapted or reused.

**Model-driven approach**
EMODE demonstrated that a model-driven approach for adaptive multimodal interactive systems is possible and proved a positive return on investment of such approach. The Roi results from the introduction of new modalities and reusability of models thanks to:

- Increased productivity – i.e. time saving in design and development phases of up to three or four times;
- Easier adaptation to new systems thanks to a new interaction architecture;
- Easier adaptation to new customers specific needs; and
- Better maintainability thanks to model manipulation, automatic generation and readability.

The second innovation of EMODE was the use of design models during the run-time phase. The use of these models provides coherence between user requirements, expressed in the models during the design phase, and the interactive systems – classical human-machine interface (HMI) plus new interactive modalities. At the end of the design process, the interaction – i.e. the use of modalities to achieve the user’s task – is the real front of the user needs and totally fits without any lack or error thanks to the EMODE approach and models.

**Demonstrated in four domains**
The approach was evaluated and demonstrated in four domains with different kinds of users:

1. Philips showed the benefit of EMODE’s approach in home-entertainment systems;
2. BASF-AG demonstrated the design and run-time approaches in the context of mobile plant maintenance;
3. Daimler used it for an in-car advanced navigation system; and
4. THALES proved its usability and efficiency in the complex and constrained domain of maritime surveillance.

**Major project outcomes**

**Dissemination**
- 4 book chapters
- 42 publications (journals, conferences and workshops)
- 6 thesis
- Industrial dissemination of EMODE’s results (MD Day’07, industrial contacts)

**Exploitation**
- EMODE’s approach and tools have been incorporated into partners portfolio (QVT Engine, Leonardi®, Intuikit®, ...)
- One trademark: THACADIA® (THALES Collaborative Activity DIagram)

**Standardisation**
- CE-HTML (Consumer Electronics-HTML standard)
- Contribution to the W3C web API group and OMG’s QVT Relational Standard
- EMODE’s thematic included into W3C working groups or incubators