MUSICAE, an infrastructure for MUlti-Surface Interaction in Context Aware Environment

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Abstract

With the advent of wireless networking and mobile devices such as personal organizers, users can always have their computer and their personal data with them. In addition, the user environment is augmented by sensors, and offers interaction resources (like wall-sized augmented surfaces) that users may use. Therefore, new challenges on software functionalities emerge, such as context-awareness and dynamic discovery of interaction resources. In this article, we present MUSICAE, an infrastructure for MUlti-Surface Interaction in Context Aware Environment.

1   Introduction

At the core of MUSICAE is IAM (Interaction Abstract Machine). IAM is an infrastructure that provides developers a uniform logical space composed of any number of processors, and interaction resources such as interactive surfaces (Coutaz & Lachenal, 2003). IAM supports the dynamic distribution of user interfaces across a dynamic set of interaction resources. Because interaction resources can be "plugged" and "unplugged" at will, IAM includes mechanisms for resources discovery and localization. Proximity and orientation information are required to maintain an operational topology. This context-dependent information is provided by contextors.

2   Contextor

A contextor (Coutaz & Rey, 2002, p. 283) is a software entity that senses environmental data, aggregates data with data provided by others contextors and computes new contextual information. Here, we define context as a state vector of observables. An observable is a variable whose value can be obtained through sensing technology and/or computed by the system (Crowley & al, 2002, p. 117).
Contextors share a common input/output structure that includes three communication channel types:
- Data channels transport contextual information. Each data channel is linked to a meta-data channel.
- Meta-data channels ensure and express quality of service measurements (QoS) such as confidence and uncertainty.
- Control channels are used by contextors to exchange control commands or QoS requests.
Contextors use a virtual peer-to-peer network to distribute contextual information to client applications such as IAM and to connect themselves.

3　IAM

IAM uses contextors to discover the characteristics and the relationships between the interaction resources. By doing so, it provides the basic information necessary to dynamically distribute user interfaces across the interaction resources available. In IAM, the topology manager is responsible for communicating with contextors. It aggregates contextor information and from there, builds the physical topology that links the current interaction resources into an interaction space.

The physical topology includes the spatial relationships between the interaction resources (e.g., "Surface 1 is above Surface 2"), it maintains the interaction resources characteristics (e.g., "Surface 3 size is 320mm x 240mm") as well as interaction resources coupling (e.g., "Surface 4 is coupled with Mouse 5"). The physical topology is essential in a multi-surface system. Augmented Surfaces (Rekimoto & Masanori, 1999, p. 378) and Rekimoto's Pick and Drop are typical examples of multi-surface interaction (Rekimoto, 1997, p. 31).

In Rekimoto's augmented surfaces, interaction resources form a spatially continuous workspace. In this setting, environmental computers are used as extensions of the personal computer that allow users to drag the graphical interface across surfaces. In the case of Pick and Drop, the user interface is distributed between two surfaces based on their intrinsic characteristics: a tool palette on the PDA and a drawing canvas on a wall-size display.

IAM uses a logical topology generator to transform the physical topology into a logical topology. This mapping is performed according to a policy that the developer selects based on the desired interaction styles e.g., (continuous, neighbourhood, etc.). Changes in the physical topology are reflected in the logical topology by generating events such as "surface appears", "surface disappears". From the developer's perspective, these events can be bound to specific actions. For instance, in the paint metaphor, when a small surface appears in the neighbourhood of the wall, the programmer can decide to create a new tool palette on this surface.

4　Conclusion

MUSICAE, which includes IAM and contextors, provides the level of abstraction needed to distribute the user interface of a system across a dynamic set of reconfigurable interaction resources. From the user's perspective, MUSICAE opens the way to the implementation of a large variety of distributed user interfaces. Due to their diversity and the dynamic nature of the topology, users may get lost. To relieve them from this cognitive load, MUSICAE includes mechanisms to maintain system observability, honesty and predictability.

5　References

Coutaz J, Lachenal C (2003). Ontology for Multi-surface Interaction. *In Proc. of Interact (Interact03)*, ACM Press.

Coutaz J, Rey G (2002). Foundation for a Theory of Contextors. *In Proc. of Computer-Aided Design of User Interface (CADUI02)*, 283-302, ACM Press.

Crowley J. L., Coutaz J. , Rey G., Reignier P (2002). Perceptual Components for Context Aware Computing. In *Proc. of the ACM conf. Ubiquitous Computing (UBICOMP),* 117-134, Springer.

Rekimoto J. "Pick-and-Drop (1997): A Direct Manipulation Technique for Multiple Computer Environments". *In Proc. of User Interface Software and Technology (UIST 1997)*, 31-39, ACM Press.

Rekimoto J., Masanori S (1999). Augmented Surfaces: A Spatially Continuous Workspace for Hybrid Computing Environments. *In Proc. of the ACM conf. On Human Factors in Computer Human Interaction (CHI)*, 378-385. ACM Press.