

# Aesthetic Awareness Displays

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**Abstract.** This research video presents a decorative artwork approach to deliver awareness information to the periphery of perception of workgroup or family members. It differs from previous “peripheral display” systems in that it puts focus on the aesthetic appearance, the user negotiated phenotypes and artwork components, the flexibility of display adaptation involving awareness themes and skins, and an open mapping of sensor data and context information genotypes to artful phenotypes. A fully functional Artful Awareness Display software framework has been developed and is demonstrated in operation while installed in a smart home setting. User experience supports the working hypothesis, that the aesthetics of art is the primary acceptance factor.

**Keywords:** ubiquitous displays, team awareness, context computing, peripheral displays, informative art, intelligent user interfaces

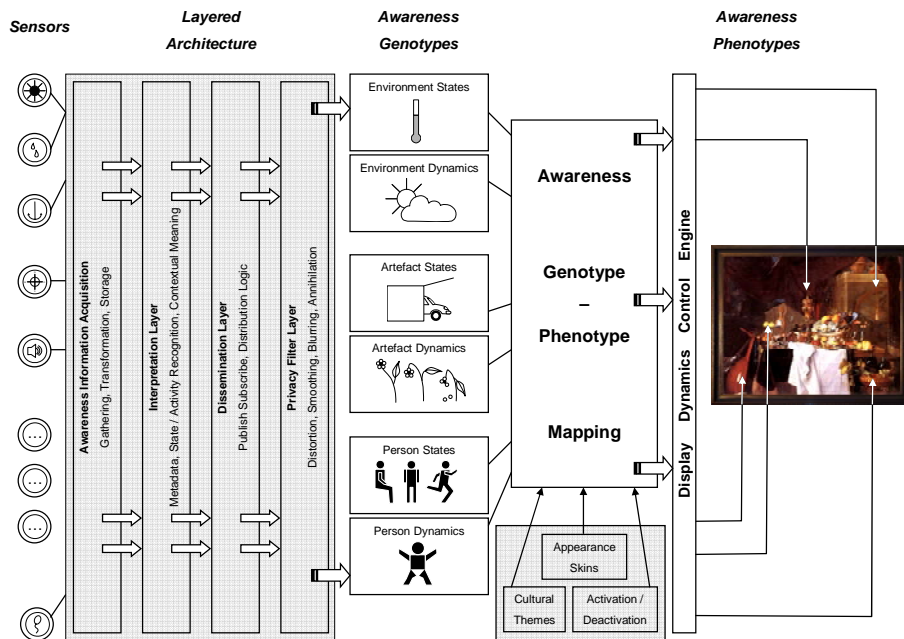
## 1 Awareness

Staying aware of each other in circles of friends, family settings or cooperative work teams is something we take for granted in the everyday world, even if interaction or collaboration is not continuously face-to-face, and family members are not continuously present or team members frequently shift from group to individual activity during work sessions. Furthermore, attentiveness to the dynamics of our home, work or office environments is either in the focus of our interest or even demanded for monitoring of control purposes. Maintaining this intuitive fidelity of awareness, e.g. of friends at the university, of kids in nursery, or of team members working in the office next door, is on the other hand something that has proven particularly difficult to attain in distributed interaction and collaboration systems, where the social interaction protocol is not as established, and the means for becoming aware of the environment are far less common. With the upcoming technological advances and miniaturization of sensor systems and wireless communication, and the continuous emergence of context aware pervasive and ubiquitous landscapes, a technology and thus distraction free support for staying aware of each other and our environment seems possible. What was intended to support cooperative work in geographically dislocated work teams to mediate an “... *up-to-the-moment understanding of another person's interaction with a shared workspace*” [4][5][6], finds a natural correspondence to any situation in our life (work, learning, education or even leisure). Outside the CSCW com-

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munity awareness has been redefined to more generally describe “*the state of knowing about the environment in which you exist; about your surroundings, and the presence and activities of others*” [19].

We hence aim at supporting any activity of individuals in a group or environmental scenario involving ensembles of everyday objects resulting from our social behavior. To maintain an intuitive, yet aesthetically appealing fidelity of staying aware of each other and the state and dynamics of our environment we propose a framework collecting arbitrary sensor data, interpreting these data as relevant context information, and to display this information in a non-technical, non-obtrusive, non-overloading, contextually meaningful, personalized and enquiring, yet adorning and artful way. The architecture of this framework is sketched in Fig. 1, covering the environmental sensing, tracking, state and activity recognition, and awareness extraction on the one hand, and the mapping of awareness genotypes to artful, aesthetic phenotypes of decorative paintings on the other hand. In our video, we present an installation of our framework in a smart home like setting, focusing on the genotype phenotype mapping and the metaphoric aspect of visualization.



**Fig. 1.** The aesthetic awareness display frameworks covers the path from collecting potential awareness data from sensors (Acquisition Layer), to the discovery of meaning in that data (Interpretation Layer), the distribution of awareness information according to publish subscribe principles (Dissemination Layer) and restraining it with respect to the preservation of personal interests (Privacy Filtering Layer). The so obtained awareness genotypes in the categories environment, artefact and person are then mapped to artwork phenotypes respecting cultural background, preference wrt. aesthetic appearance, and personal settings. A control engine finally steers the dynamics of the physical awareness display.

## 2 Aesthetic Presentation of Awareness Information

Peripheral displays were proposed to provide users with information considered relevant at arbitrary points of work or living engagement, originating from many different –mostly geographically dislocated– sources and presented at the periphery of human (visual) perception [11]. Having the displays operate in the periphery of a user's awareness allows other user tasks to sustain primary [7]. Much like the information presented by clocks, posters, paintings or windows, peripheral displays move to the center of attention only when appropriate and desirable. Computational counterparts of such displays have been designed to support group awareness in work groups in virtual space settings [4], for knowledge dissemination in enterprises[15], for users of instant messaging systems [3], for deaf users [8], to keep in touch with family members [17], or to display a cities health information in public places [1] – to name a few. Metaphorically, abstract art has been proposed to serve as the visualization paradigm for contextual information [18], design principles and guidelines have been developed [12], upon which software frameworks and development toolkits [14] have been built. Evaluation guidelines [2] have been developed [10][13] and assessment studies have been conducted, e.g. relating comprehension of peripheral displays (i.e. how well a user understands and uses such artifacts) to the time span of their use [9].



**Fig. 2.** Informative Art [18] (*left*), inspired by Mondrian, in real time shows the expected weather situation or urban bus traffic situation; PeopleGarden [20] shows user activities in terms of message densities from posting onto a message board (*center*); InfoCanvas [16] (*right*) displays multiple sources of information ranging from NASDAQ Composite Index to the number of employees present at work in real time in a beach scene.

What appears to be critically important for the design of awareness displays is the *conceptual structuring* of awareness information related to

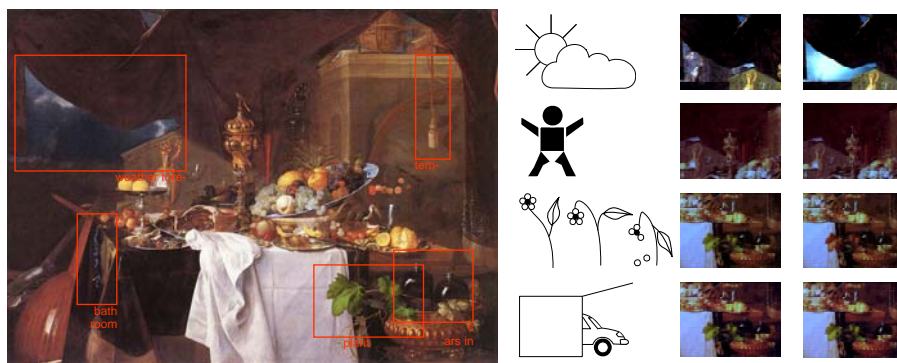
- (i) its *purpose* (while *task awareness* relates information to work objectives or the steps undertaken to reach goals in the work plan, *social awareness* relates to the presence, availability and activity of people)
- (ii) its *contextual relevance* (*What* constitutes the environment (workspace, living space, leisure space) one wants to be aware of? *Who* takes part in a certain activity? How active are people (*activity level*) and what do they do (*actions*)? *Where* can people or things affect changes (*sphere of influence*) and what are the *intentions* and *expectations* of people while acting in the environment?)

- (iii) its *perceivability* (the perception of relevant elements of the environment, the relevant artifacts and relevant people and the comprehension of those elements, i.e. observers must be able to integrate the perceived perceptual information with existing personal or group knowledge and make sense of this information for the current situation.

## Conclusions and Findings

Particularly to support the issue of perceivability we have developed design criteria and the corresponding framework architecture components (see Fig. 1), which we summarize as follows:

- (i) *Cultural Context*: The individual appreciation of visual designs and the aesthetic appeal of artwork is highly related to the cultural understanding a person lives in. Our framework for awareness displays offers a choice of artwork metaphors relating to the cultural context of its use. As opposed to metaphors proposed in previous work (see Fig. 2), our framework particularly supports original fine arts paintings, in the example presented in the video e.g. a “Stilleben” by Jan David de Heem, a dutch painter in the early 17th century.
- (ii) *Aesthetic Appeal*: As a means of personal emotional expression our framework allows to modify the visual appearance of color, light, smoothness, shininess, brightness, etc. in the paintings by the means of “emotional skins”. Controllable aesthetic attractiveness has turned out to be the dominant factor of display appreciation.
- (iii) *Comprehension and Continuity*: From prototypical installations we have learned that changing modes of display, or even the metaphor, severely disrupts the continuity of comprehension. To minimize distraction generated by the occurrence of status changes, very (!) soft blending and smoothing techniques are deployed to the visuals and graphics by the display control engine.



**Fig. 3.** Aesthetic awareness display based on Stilleben by dutch baroque Jan David de Heem with mappings of weather conditions, baby monitoring, flower watering and garage monitoring.

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