Ambient Communication Experience (ACE)

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Abstract

Ambient Information Systems (AIS), permit a mode of expression that can easily exist at the level of subconscious realisation. Principles of cognition are usually aggregated under the main auditory, visual and often innovative tactile sensory impetus. AIS are designed principally for the aesthetic communication of non-critical information. This research focuses on the development of an Ambient Communication Experience (ACE) system. ACE is a synchronisation framework to provide co-ordinated connectivity across various environmentally distributed devices via sensor data mapping. The intention is to facilitate location-independent and application-responsive screening for the user, leading to the concept of technologically integrated spaces. Technologically integrated spaces have the potential to change our perception of information and our behavioural interactions associated with its provision. The aim is to deliver contextual information without the need for direct user manipulation, and engagement at the level of peripheral perception.

1   Introduction

Mankoff and Anind (2003) define the development of ubiquity as relying on the concept of user periphery; as any individual's full attention can only be factored to a few applications at any given time. They characterise the success of ambient displays, or ambient information systems as having the capacity to modify the awareness of the user. In turn these systems have the potential to adapt the behaviour of individuals based on the embodied information of the display. Often ambient information bears relevance to only a few individuals, at any given time; therefore the consideration of aesthetics is elementary to such designs, especially when incorporated in work spaces. Ferscha, Emsenhuber, Schmitzberger and Thon (2006) place critical importance on the values of 'purpose', 'contextual relevance' and 'perceivable cohesion' in the conceptual structuring of awareness information. Ambient systems should remain secondary to the primary work task, yet still be easily comprehendible. Within the context of moving information from the periphery to the centre, another important factor is that of user cognitive state (Mankoff & Anind, 2003). Cognitive state is reflective of the users' in situ and the systems ability to augment their consciousness through sensory

perception and cognitive behavioural interactions. System activity is operating on users' multimodal senses below the threshold of consciousness, requiring only subconscious recognition (Baars & Mc Govern, 1996). Screen based media and associated physical architectural space provide the medium for investigative studies in this area. The behavioural characteristics (as defined by Pousman & Stasko, 2006) of ambient information systems include the following:

- o The presentation is of non-critical information.
- o Information that can move from the periphery to the centre of the user's focus.
- o The concentration is on 'the tangible' in the form of real objects in the environment.
- o AIS provide non-distracting subtle changes reflecting information updates.
- o AIS should in essence be aesthetically pleasing and environmentally suitable (Pousman & Stasko, 2006).

They further elaborate on the design space of AIS by defining the dimensions that create it: (i) reflecting on the information capacity of the system; (ii) the possible notification level of the design; (iii) representational fidelity from within the product; (iv) the aesthetic emphasis of the presentation (based on the work of Ferscha et al., 2006). Finally they propose an evaluation framework based on these dimensions (see Pousman & Stasko, 2006).

2   Motivation

The main motivation for this research is to provide sensor-activated communication. This will enable contextualised content viewing. Mobile devices offer convenient communication capabilities and have the potential to create intermediary support for the user and their environment enhancing an intelligent space. The ACE system's function is in the autonomous realisation of a user's presence through Radio Frequency IDentification-RFID readings with the expected objective of delivering contextual personal preferences permitting implicit interaction within the system. This communication will permit a many to many (n:n) exchange via shared distributed devices utilised in smart architectural space enabling the creation of surround and fluid protean displays. The 'ambientROOM' project is an example of such but incorporating a broad range of various interactions from light patches, soundscapes and water ripples. The aim of 'ambientROOM' is to extend and augment Human Computer Interaction beyond computer screens (Wisneski, Ishii, Dahley, Gorbet, Brave,

Ullmer & Yarin, 1998). Carbonell (2006) reflects on ambient interface interactions as having to be reconfigured for throughput to output terminals of varying media and screen dimensions. This concept is reflected in the ACE system components of PC, PDA, flat screen and smart mobile phone, and possibly further mobile devices and stationary artefacts. A one to many (1:n) configuration is substantiated when a user's tag reading activates a within range device display. Implementation of these constraints gives rise to 'interface plasticity' and 'adaptive multimodality' (Calvary, Thevenin, & Coutaz, 2003). However maintaining simplicity whilst asserting notions of 'calm' remains the consummation in these phenomena and a reflection of the technology we seek (Weiser, 1991).

The classic AIS example is Jeremijenko's Display Installation entitled 'Live Wire', which attracts either aural or visual attention as the incitement requires. More recent ambient displays include 'The Kandinsky system', which generates aesthetic information collages converting textual input to image output (Fogarty, Forlizzi & Hudson, 2001). 'IMPACT' monitors daily physical activity and provides feedback through detailed and abstracted displays (Forlizzi, Li, & Dey, 2007). 'Ambient Orb' presents ambient information through wireless configurations to track personal portfolio interests such as market shares. 'Hello.wall' uses a large ambient display coupled with a hand-held device exploiting the ability to perceive information via codes (Vogel & Balakrishnan, 2004). Consistently the purpose is to refine knowledge to a symbolic representation requiring little cognitive effort. An ethical issue that arises is that the abstracted notation of information is reliable and consistent for the initiated users specified; otherwise it could lose all purposeful functionality. Privacy related data for example may need to be tagged as 'sensitive' and filtered away from any public audience.

3   ACE Architecture

The key components of ACE (Figure 1) collaborate to ensure continuity of the user experience and include a sensor network, web server, session server, and user session client (to store user history, cookies, current web page state and bookmarks amongst other user facilities) to different displays.
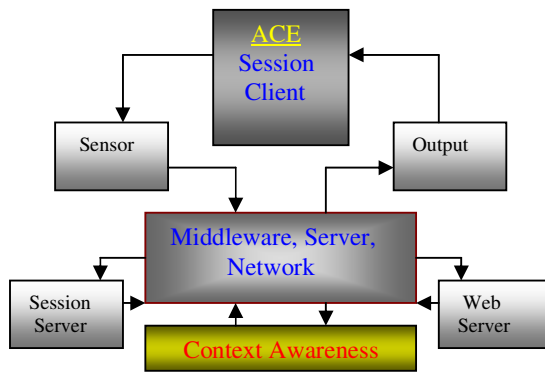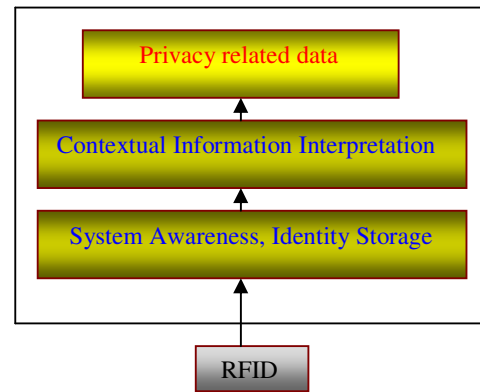
Figure 1: High-level schematic of ACE

Figure 2: Context aware components

The server side can act as a coordinator to manage the data, and facilitate screen resizing before exporting content to a newly activated device. The client side component will have the necessary functionality to manage session synchronisation. The server must also maintain a user's personal profile and orchestrate this profile to heterogeneous devices within dynamic environments. In addition the server will also be responsible for carrying out routine authentication and authorisation and provide session state and mobility handling within the system. The components associated with context awareness (Figure 2) facilitate user recognition, identification and storage within the first layer, with interpretation of this information addressed at level 2. Privacy related data may need to be tagged at level 3 as 'sensitive' to enable security filtering of data for display purposes.

Amongst the challenges for this system, there exists the requirement to work in real-time and to cope with varying levels of ambiguity, such as changes in user predilection, user idiosyncratic actions and weak sensor signals. Adaptability to new heterogeneous devices and amended environments will result in readjustment to meet user specification and compensate for device failure supporting integration and interoperability. Whilst dynamically adapting to user requirements through reconfiguration, 'trust,' 'security' and 'safety' standards must also be adhered to, and integrated into the system design. The core of the application architecture is to provide natural interactions and hence requires abstraction of the underlying technical communication infrastructure; hiding complexity, whilst enhancing experience and confidence. Successful ubiquity however, requires appropriate transparency integrated into the ecology of ones environment facilitated through peripheral interfacing.

The ability to capture the context of the user in state, application and service requires interpretation of 'W6'; the 'Who?,' 'What?,' 'Why?,' 'Where?,' 'When?' and 'hoW?' and is central to the design and profile of the user. Context is argued to be a feature of interaction in any human-computer symbiosis (Dourish, 2004). It is based on the premise that intelligence is action orientated and context can be used to bring order and clarity to unclear situations in order to deliver appropriate actions. Therefore context is seen as a tool for action selection. Within ACE providing device interchange while sustaining the capabilities and resources of the current screening is part enabled by context awareness. Location information is another form of context aware information within ACE. A migration theory associated with user perception may also be incorporated further into the design of ACE as a means to capture key information concerning the user. This modelling may need to encapsulate the user's intentions towards a particular display terminal, taking into account the capabilities of the display equipment and the surrounding interface options. This will provide additional information for the user, concerning the information content and available screen display real estate.

4   Conclusion

As technology advances, art begins to resemble science; the interpretation of data through artistic creations reflects a form of compression. "*Content and presentation become everything; form and function must be fused*" (Walker, 2003). It has been noted amongst the theorists of Cognitive Science that much of cognition concerns compression (Wolff, 1982). AIS systems are reflective of cognitive systems in that they unite cognitive economy and principles of information compression, where the main goal is in the concentration and computation of data and the encoding to a form that is later retrieved and comprehended (Chater, 2002; Wolff, 2006). Many aspects of cognition, from perception, language acquisition, to high-level cognition involve finding patterns that provide the simplest explanation of available data enabling categorisation and causal relations. The emphasis is on simplicity, and ease of use. Denning and Metcalfe (1998) affirm, "*to become attuned to more information is to attend to it less*," this is where the design of AIS resides, and is the context of this research.

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