Context-Awareness in Ambient Intelligence

Declan Traynor, University of Ulster, UK
Ermai Xie, University of Ulster, UK
Kevin Curran, University of Ulster, UK

ABSTRACT

Ambient Intelligence (AmI) deals with the issue of how we can create context-aware, electronic environments which foster seamless human-computer interaction. Ambient Intelligence encompasses the fields of ubiquitous computing, artificially intelligent systems, and context awareness among others. This article discusses context-awareness and examines how discoveries in this area will be key in propelling the development of true AmI environments. This will be done by examining the background and reasoning behind this particular strand of AmI research along with an overview of the technologies being explored alongside possible applications of context awareness in computing as well as technological and socio-ethical challenges in this field.

Keywords: Ambient Intelligence, Artificial Intelligent Systems, Context Awareness, Context-Aware Environments, Human-Computer Interaction, Ubiquitous Computing

1 INTRODUCTION

Context awareness can be defined as “...any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves” (Dey & Abowd, 2000). This definition makes no assumptions about the types of information which are relevant to context such as time, location, identity and so on. Following the more open ended definition above caters for situations where the context may be derived from one, many or all of these types of information as well as other types of information which are not defined from the outset. This understanding of context is necessary in creating truly intelligent environments for the future which are extensible in order to keep up with the rapidly changing and increasingly diverse contexts in which human-computer interactions are taking place.

Context-Awareness in computing can be seen as the existence of computer systems and applications which can gather and make sense of “information about the immediate situation—the people, roles, activities, times, places, devices, and software that define the situation” (Vian et al., 2006) and then demonstrate the appropriate related behaviour based on the perceived context. Such behaviour
might include the presentation of customised or specially formatted information or the performance of some action to avoid a potentially hazardous situation. Future revelations in the area of context-awareness have the potential to dramatically improve the way in which ubiquitous and intelligent computing environments support our everyday activities as well as provide richer experiences in human-computer interaction.

Ubiquitous computing expert Mark Weiser talked about a new wave of pervasive computing which he described as “the age of calm technology, when technology recedes into the background of our lives” and where computers would be “embedded in our daily lives and supporting them.” Research into context-aware computing holds the key to realising this vision of seamless human-computer interaction where all information relevant to context will be gleaned automatically by intelligent systems. When discussing this point it is important to re-evaluate what environmental information is relevant to context. For example, information on the identity of users might be implicitly gathered by the application as the user approaches the computer or the point of interface. This could be done using facial recognition, for example. Alternatively, the user might explicitly provide identity information to the application via a more conventional log-in prompt. In both cases, the information on the user’s identity provides context but in the latter case the system is not necessarily intelligent or context-aware. If we were to have computing devices embedded in our environments but we still had to interact explicitly with them, then we would gain no real benefit from the ubiquitous computing paradigm. In fact, copious devices and computer applications which expect explicit user involvement would serve as more of an hindrance in carrying out our everyday activities rather than a means of supporting them. In order to achieve the sort of innovation discussed by Weiser and others, we must continue to investigate and develop truly context-aware applications which can gather and make sense of information relevant to the current context and then exhibit some behaviour depending on the context. Some of the possibilities for Ambient Intelligence to support our daily activities include working out quick routes for car journeys and applications which infer our shopping list by gathering information about the contents of our fridge and combining this with the information that you are having friends over for dinner (Shadbolt, 2003). In this sense, these applications must be truly context aware so that they integrate seamlessly into people’s daily lives and avoid becoming “ubiquitous clutter” rather than useful pervasive computing services.

Context-aware computing might also hold the key to opening up communication between people and computers as people have an implicit understanding of context and how this enables rich person-to-person interaction as despite massive advances in both hardware and software interfaces, people still maintain an “impoverished mechanism” for interacting with computers (Dey & Abowd, 2000). Many researchers in the field of context-awareness are looking at how context-aware computing could lead to richer human-computer interaction and the provision of more relevant and useful services to the end user. An example of this is a context-aware tour guide which could sense a user as they approach specific exhibitions. Such a guide could take information on location of a user and combine this with the exhibitions they have visited previously to form an understanding of the context and then present tailored information which will be relevant and interesting to the user in that instance. Another example might be a computer application which senses the presence and proximity of a user’s mobile devices. Suppose the user had information about their business meetings stored on the device. A context aware application might be able to automatically discover such information and synchronise it with the user’s calendar information on their home desktop. The application might be able to resolve conflicts in the user’s timetables or automatically schedule reminders for future activities. Such automatic coordination of information to create more useful services is just one of the many examples of how
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