



Editorial

The social implications of emerging technologies

1. Introduction

Emerging technologies are at the forefront of technological innovation and research. In proposing this special issue, we linked the term emerging technologies with research areas such as intelligent, mobile and pervasive technology, as well as collaboration and communication technologies. Such technologies are characterised by their widespread use and presence. Their design has been focused on specific tasks such as communication, games and assistance. Their presence and use makes emerging technologies a major factor affecting peoples lives, making the social implications of emerging technologies important both in research and in practice.

With this special issue of *Interacting with Computers*, we wish to provoke a thoughtful exploration of the social characteristics of emerging technologies. These characteristics may be inherent or attributed by users. An understanding of these social issues may also provide a rich source of design ideas and improvements. The increasing use of emerging technologies in our daily lives implies that the design decisions we make have a direct impact on our lives. Consequently, ideas for the improvement of our designs can have a direct beneficial impact on our lives.

Intelligent, mobile and pervasive technology is emerging from laboratories and pervading everyday environments such as the home and the streets, entering the conscience of an ever-increasing part of the general public. Emerging technologies touch upon several important social issues, other than the often-cited issue of privacy. As researchers begin to identify and address these critical issues, we believe it is important to establish an open community dialogue to share these findings, create awareness regarding new research in these areas, and collaborate to work towards new challenges. This special issue acts as an initiator of such a dialogue.

2. Emerging technologies and their social impact

The effects of technology on society have been observed and recorded for thousands of years. Arbitrarily, we can begin to observe the effects of technological innovation on society with the discovery of fire and the invention of the wheel, technologies that had

profound impact on society and the survival of the human species. Subsequently, the invention of writing and the press, as well as the scientific understanding leading to industrial revolution are all examples of how the advancement of technology can have deep effect on society, social structures and behaviour. The 20th century was characterised by the advent of mass communication technologies: the telegraph, telephone, radio, television and finally the Internet have forever changed the internal workings of our society and social structures.

Communication media have been studied for their effect on society and social relationships. Although we observe an impact of these technologies, the debate regarding their positive and negative effects continues. For instance, the potential use of mass media for a wide array of purposes ranging from education to propaganda has fuelled debates and arguments for decades. More recently, the Internet has provided grounds for often heated debate. Despite it having been around now for almost two decades, its consequences for society are still unclear.

Researchers and social critics are debating whether the Internet is improving or harming participation in community life and social relationships. Indicatively, a recent longitudinal study (Kraut et al., 1998) examined the effects of the Internet on social involvement and psychological well being of people during their first 1–2 years on-line. The results show that although the Internet was used extensively for communication, greater use of the Internet was associated with declines in participants' communication with family members in the household, declines in the size of their social circle, and increases in their depression and loneliness. Yet in another study (Howard et al., 2001), many participants reported substantial benefits from being connected to the Internet. Over half of Internet users felt that the Internet has improved their connection to family and friends. As the Internet and its use mature, so will our understanding of its impact. It is not entirely surprising that a technology that has been around for a few decades is still not well understood in terms of its social implications. We expect the same to hold for current emerging technologies.

Since the establishment of the Internet, technology has come a long way. Our society has now entered a transitional period in terms of computer technology. Computers are no longer a luxury or an expert tool. Although we have moved towards the vision of the information society, until recently the limit of the information revolution was quite observable: the computer. The desktop computer symbolised the access point, the portal into the information highway, and therefore, by switching the computer off one became disengaged from the information society. Now, we are in a transitional period of debate and technological innovation that will allow us to place computing infrastructure potentially everywhere, with the prospect of making it invisible to the users as well as intelligent and reactive to the users' needs and the environment. Everyday objects and locations will become portals with digital identity and awareness of their users and environment, offering new ways of communication and new possibilities for interaction.

As with the Internet, our understanding of the characteristics and social implications of emerging technologies is still quite limited. For instance, there is an ongoing debate on the usefulness of 'invisible' computing as opposed to exposing or externalising the technology. Different designs may have different effects on users' behaviour and understanding of the system. Furthermore, context aware and intelligent technology has

had its share of debates, with the classic example of the Microsoft paperclip providing a benchmark for making context aware technology useful, especially in a social context. Moreover, the social context has been the main focus of emerging communication technologies aiming to bring groups of people closer together by allowing them to communicate using multiple channels over great distances. Our understanding of the social impact of such technologies is still inconclusive, especially in areas such as collaboration using communication technologies.

We now examine some important research areas from the perspective of social issues and implications. The areas we examine—mobile and pervasive computing, context awareness, communication technologies and social intelligence—are representative of emerging technologies as well as of the papers that have been included in this special issue. Here, we ask questions which are subsequently addressed by the papers in this special issue.

2.1. Mobile and pervasive computing

Mobile and pervasive computing is a research area aiming to make the best use of miniaturised, mobilised and intelligent technology in everyday environments. Also known as ubiquitous computing, its main objective is the digital augmentation of everyday objects and locations as well as the provision of digital information regardless of location. Besides the theme of adding processing, storage and communication capabilities to objects and locations, a related theme within this research area addresses the issue of making these computational capabilities ‘invisible’. This invisibility can either be achieved literally by making very small digital components, or by making these components so familiar to use that we no longer focus on them. Despite the debates taking place regarding the ultimate purpose of pervasive or ubiquitous computing, the important idea remains the same: computation will flood out of the computer boxes and into our environment, infusing everyday objects like umbrellas, shoes and coffee mugs.

With the advent of pervasive systems, computing systems are becoming a larger part of our social lives. Depending on the design of these systems, they may either promote or inhibit social relationships. [Dryer et al. \(1999\)](#) identified four distinct types of social relationships in relation to pervasive computing: relationship with the system, system-mediated human to human relationships, relationships with a community, and interpersonal relationships among co-located persons. The same work shows the design of pervasive computers to affect responses to social partners, and also proposes a model of how pervasive systems can influence human behaviour, social attributions, and interaction outcomes.

Furthermore, it is expected ([Jessup and Robey, 2002](#)) that pervasive computing technologies will not only extend existing social conventions, but will also enable new ways of acting and interacting, and will stimulate a reassessment of what constitutes human action and interaction. In some cases, social actions will occur in entirely new ways, and in other cases, completely new social actions will appear. What will those new social actions be? How will they be observed? How will they affect current social actions and interactions?

2.2. *Communication technology*

Technology is increasingly becoming important as a way of mediating communication and social interaction. Systems are developed that impact upon both our personal and professional lives. The advances made in technology have unchained the user from the desktop into interaction spaces where access is anywhere, anytime; a place where communication is seamless and invisible. As systems become more ubiquitous and free the user from time and place, research suggests that although anytime, anyplace may be possible it may not always be acceptable (Perry et al., 2001).

Humans interact with technological systems in a variety of different environments. The role of technology within social interaction is increasing as more and more people use a host of different devices for a multitude of different reasons (Myers, 1996). Systems are used for communication purposes related to our work, home, leisure, entertainment, travel and health (Damodaran, 2001). People can be contacted or contact others, surf the web or find out the latest football score on their latest portable mobile device anytime, anywhere.

Individuals' behaviour in any social setting differs and is dependent upon with whom or what they are interacting. How to interact appropriately in a given situation is drawn from the environment, individual's expectations, cultural and social norms of behaviour. The use of communication technologies in everyday interaction highlights how context and communication change (Rasmussen, 1997). For example, a conversation on a mobile phone is generally between two people who do not share the same physical setting.

As we have discussed, the future predicts computation embedded in our daily lives through the development of ubiquitous technologies. A number of questions are raised in relation to the communication capabilities of such technologies. How will people choose and control what information is revealed at any one moment and to whom? What level of awareness will the technologies exploit in order to deliver information in a timely and convenient fashion? The social impact of such technologies is vast. If our understanding of factors that influence use is not better developed, users may perceive systems as threatening, intimidating, risky and difficult to use. Users may abandon systems and become less tolerant of them. When considering future communication systems, context of use becomes even more important due to the types of technology and the levels of social interaction (Gasen, 1996).

2.3. *Context awareness*

In the vision of a pervasive computing environment, people are able to conduct their everyday life activities and, at the same time, access information or use computing services at any time and in any place. As a result, the user's attention may be divided between several simultaneous activities. Moreover, as mobile devices such as PDAs become ever smaller, their physical interfaces and the interaction techniques that are coupled to them are becoming increasingly less usable. Through the notion of context awareness, researchers have attempted to improve user interaction by exploiting information relating to people, devices and environments. Context awareness has the potential to play a key role in reducing the need for explicit input, thereby, making interaction easier and less error prone.

Researchers in the context awareness field produce different definitions and classification systems that cover various elements of context. For example, [Benerecetti et al. \(2001\)](#) have classified context broadly into physical context and cultural context. Physical context is a set of features of the environment while cultural context includes user information, beliefs and the social environment. Many researchers have tried to classify context so that the classification can be used to make sense of human behaviour. Each approach covers different elements of context for reasoning about human behaviour. Some approaches cover subsets of another. Classifications tend to cover different types of context depending on how the researchers use the classification in their applications, and context aware applications have generally utilised only isolated subsets of their context, such as a location or a device's state. A truly context aware system needs to take account of the wide range of interrelated types of context and the relationships amongst them, including people's individual and social behaviour.

In turn, the successful development and widespread adoption of context aware systems will have major impact on people's use of technologies, relationship with technologies and relationships with each other. A social world populated both by people and by context aware technologies will support and augment existing social relationships and will enable new forms and expressions of social relationship. For example, the concept of 'stranger' cannot be the same when our PDAs and phones can communicate with each other and with us about the shared interests of those around us ([Paulos and Goodman, 2004](#)). How we manage such information—or context—sharing has implications both for system and interface design and for social norms, laws and relationships.

2.4. Social intelligence

Social intelligence is a heavily researched and much debated topic in several psychological fields including developmental psychology and psychometrics. Unresolved issues regarding definitions and measurement of social intelligence persist despite attention from HCI practitioners. Social intelligence is at its basic level the ability to deal with people. Whilst precise definitions vary, key dimensions of social intelligence are thought to include:

- Situational radar: the ability to read situations and to understand the social context that influences behaviour;
- Presence: the external sense of self that others perceive, e.g. confidence, self respect and self worth;
- Authenticity: the ability to be honest with oneself and with others;
- Clarity: the ability to express oneself clearly and to use language effectively;
- Empathy: the ability to create a sense of connectedness with others.

In practice, the manifestation of social intelligence is almost entirely dependent on the context at hand, presenting a number of interesting issues for those involved in the design of new and ambient technologies.

Social intelligence came to prominence in HCI with the recognition that people often automatically and unconsciously follow the same rules in their interaction with computers

and interface representations as in social interaction with other people (Reeves and Nass, 1996). This led to the idea that the principles, traits and behaviours which are conducive to positive social interaction between people, i.e. social intelligence, could be used to engender positive interactions between different technologies and their users. So is it the case that the higher the perceived social intelligence of inanimate technologies the more people like them, trust them and use them? The literature has been contradictory in this respect (see Dehn and van Mulken, 2000) with well-documented examples of poorly received socially intelligent technology. Gong (2002) suggests that we need to consider four principles of social intelligence in relation to technology. These are attractiveness, affectiveness, adaptiveness and appropriateness.

Bearing these points in mind, the research reported in this special issue raises a number of interesting questions. To what extent do we expect different forms of technology to display social intelligence? Are there some situations where we expect the technology to 'keep quiet' and not to behave in a human-like manner? Will the technology be suitably adaptive to our needs and understand when it is appropriate to communicate with the user and when it is not? In terms of attractiveness and affect, does the very appearance of a technology affect perceptions of social intelligence?

3. The contents of this special issue

We start this special issue with a review of the social issues involved with the design of technology. More specifically, the first paper is authored by Abascal and Nicolle and is entitled *Moving towards inclusive design guidelines for socially and ethically aware HCI*. In this paper, the authors offer a survey of emerging technologies and associated design issues. The authors focus on the issues involved in technology design for disabled users, as well as the use of design guidelines to assist inexperienced designers in addressing these issues and in implementing legal accessibility requirements. The central argument of this work is that the design of universally accessible interfaces has a positive effect on the socialisation of people with disabilities. People with sensory disabilities can benefit from computers as a means of personal direct and remote communication. Personal computers can also assist people with severe motor impairments to manipulate their environment and to enhance their mobility by means of, for example, smart wheelchairs. In this way they can become more socially active and productive. Accessible interfaces have become so indispensable for personal autonomy and social inclusion that in several countries special legislation protects people from 'digital exclusion'. The authors propose a number of inclusive design guidelines for designing information technologies for universal access. The aim of the guidelines is to avoid social exclusion of people with different disabilities.

Having addressed the important issue of technological design for disabled users, our special issue carries on with two studies focusing on the home environment. The first study is authored by Markopoulos, Ijsselstein, Huijnen and de Ruyter is entitled *Sharing experiences through awareness systems in the home*. The authors set out to test the hypothesis that providing peripheral awareness information to support primary groups of socially close individuals in sharing an event or activity at remote locations will yield

affective user benefits such as social presence and group attraction. The study involved a practical experiment. Individuals belonging to a primary group were asked simultaneously to watch a football match on TV, either individually or in small groups, in separate rooms, while being supported by a technology allowing remote perception of the other people watching the match. Two awareness systems were used: a sketchy vision system and a full video vision system. The communication system was clearly operating in the background, the central task being ‘watching the match on TV’. The authors conclude that, under the experimental conditions, a full vision background system enhances social presence and group attraction, both for single or group viewers. The experiment has shown that providing awareness information increases social presence and group attraction felt by individuals towards remote partners. In other words, good quality video footage of friends who are not physically present enhances social presence.

The next paper in this special issue looks at the impact of robotic technology, demonstrating social intelligence in the context of a home environment. This paper is authored by de Ruyter, Saini, Markopoulos and van Breemen, and is entitled *Assessing the Effects of Building Social Intelligence in a Robotic Interface for the Home*. This paper proposes that providing peripheral awareness information to support primary groups of socially close individuals in sharing an event or activity at remote locations will yield affective user benefits such as social presence and group attraction. In addressing their hypothesis, the authors explore the concept of social intelligence in the context of designing home dialogue systems for an Ambient Intelligence home. The experimental procedure utilised a Wizard of Oz set-up. The experiment involved a robotic interface capable of simulating several human social behaviours. The results of this study suggest that, under experimental conditions, social intelligence is an important dimension affecting user response to robots. This study indicates that a home dialogue system with some social intelligence increases user acceptance and triggers social behaviours towards the device.

The final paper of this special issue provides an interesting study and comparison of how emerging technologies are used outside the home and on the streets for supporting social group activities such as rendezvousing. This paper, authored by Dearman, Hawkey and Inkpen, is entitled *Rendezvousing with Location-Aware Devices: Enhancing Social Coordination*. This paper presents a study of evaluating and comparing the use of mobile phones and location aware handheld devices. In this field study, the authors analyse a set of scenarios to study the impact of location-aware devices on social coordination and rendezvousing. It is reported that participants took part in one of three mobile device conditions (a mobile phone, a location-aware handheld, or both a mobile phone and a location-aware handheld) and completed three rendezvousing scenarios. The results reveal key differences in communication patterns between the media, as well as the potential strengths and limitations of location-aware devices for social coordination. The authors conclude with a discussion of design issues drawn from observations gathered during the field study. The major contributions of this paper include furthering our understanding of how location-aware technologies can be used to address existing problems, and also how to run an evaluation of a mobile location aware application in the field.

4. Conclusion

HCI draws much of its strength from being an interdisciplinary subject. This strength is showcased in the papers presented in this special issue, which examines the social implications of emerging technologies from a variety of standpoints. The discipline of Human–Computer Interaction has potentially much to contribute in moving us closer to the vision of widespread, if not universal, access to technology and computer resources. HCI may contribute from informing the design of relatively trivial interface features to ensuring that the wider social implications of such systems inform their design and development.

Unfortunately, theoretical development has not kept pace with technical development, a problem of very long standing in HCI (Barnard, 1991). We hope that the work presented in this special issue provides a step towards understanding and designing technology in society. Nevertheless, the technology is evolving much more quickly than society. For successful emerging technologies, we need to work now to have a better understanding of the social and design issues before the technology arrives to turn them into social and design opportunities or problems.

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