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Locating 'Agency' Within Ubiquitous Computing Systems

Abstract:

The final shape of the "Internet of Things" ubiquitous computing promises relies on a cybernetic system of inputs (in the form of sensory information), computation or decision making (based on the prefiguration of rules, contexts, and user-generated or defined metadata), and outputs (associated action from ubiquitous computing devices). My interest in this paper lies in the computational intelligences that suture these positions together, and how positioning these intelligences as autonomous agents extends the dialogue between human-users and ubiquitous computing technology. Drawing specifically on the scenarios surrounding the employment of ubiquitous computing within aged care, I argue that agency is something that cannot be traded without serious consideration of the associated ethics.

Agenda:

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Introduction: Ubiquitous computing and the aging population

The aging of the population is one of the major transformations to be experienced by global populations throughout the 21st century. The Australian Bureau of Statistics (ABS) writes that the proportion of older Australians is expected to increase over the coming years, with the population aged 65 years and over projected to increase from 2.5 million in 2002, to between 6.1 and 11.7 million in 2101.

The potential need for support among the frail aged – for example in the areas of assisted housing, health, and disability services -- suggests that the associated costs to care for this cohort will be significant. We can assume that it is better both socially and economically to care for older people in their own homes or in accommodation joined to other family dwellings to delay the requirement for institutionalisation. Ubiquitous computing systems have both a unique opportunity and an important role to play in keeping the elderly in the home environment, or at least out of institutional care.

A range of scenarios have been outlined in which ubiquitous computing systems are employed to assist in the management and care of an aging population. These range from the technological gadgets that might help an elderly person go about everyday tasks, including safety devices, dementia aids and people locators, to the systems that enable easy access to medical experts and expert systems, improve in the early diagnosis of diseases associated with age, improve the tracking of disease, and provide a range of measures associated with record keeping. Medical information could be gathered via direct sensor-based monitoring through ubiquitous computing devices located in the body through implant technologies, incorporated in smart fabric clothing or other wearable devices, or embedded anywhere within the smart home[1]. Ubiquitous computing systems might also incorporate software that allows alternative input through gesture, voice, hand and head movements, remote control, or feedback from other haptic devices. Attached to or embedded into walls, appliances, beds, vehicles and other household applications, ubiquitous computing systems could enable the elderly to maintain everyday life within the home with greater levels of ease and comfort. Ubiquitous computing could also facilitate the automation and maintenance of systems associated with shopping, transport, medication, health-care routines, or the often difficult scheduling of complex familial occasions and other social and cultural network opportunities.

As Emile Aarts and Stefano Marzano[2] have argued, the goal of ubiquitous computing is to go anywhere and be everywhere, effectively rendering time and space invisible and inconsequential. The consequence of such a vision is that established relations of power and control may be similarly rendered inconsequential. While the political implications surrounding agency within ubiquitous computing systems has a reach largely beyond the scope of this paper, it is important to articulate some basic questions and concerns around issues of power, control, and agency that arise due to the employment of ubiquitous computing systems within the everyday life of an aging population.

In this paper I argue that the surrender of a certain degree of agency to ubiquitous computing systems is a trade that should not be taken lightly or without deeper inquiry. Adam Greenfield[3] outlines an interesting argument, drawing on McLuhan's *Understanding Media*[4] to suggest that the employment of ubiquitous computing systems will, like all technologies, involve a kind of "willed surrender". When McLuhan argues that every technological 'extension' of human faculties corresponds with an 'amputation', he is suggesting that while our reliance on new technological systems may relieve some of the burdens of everyday life, our organic faculties are likely to "atrophy to a corresponding degree" (the automobile may take us further but we might, for example, exercise less). Within the context of elderly care, patients, family, and health-care professionals need to be able to clearly justify what it is about the nature of 'everyday life' that can be effectively 'improved' through the augmentation and supplementation that ubiquitous computing systems provide. In other words, as these technologies

[1] Burgelman, Jean Claude and Punie, Yves: Information, Society and Technology. 29

[2] Emile Aarts and Stephano Marzano: The new everyday: Views on ambient intelligence.

[3] Greenfield, Adam: Everyware: The dawning age of ubiquitous computing. 148-150.

[4] McLuhan, Marshall: Understanding Media: The extensions of man

become ordinary and pervasive aspects of everyday life, it becomes increasingly important to be certain about what it is, exactly, that is exchanged through the amputation/prosthesis process ubiquitous computing systems provide. As Greenfield writes:

> *"If a reliance on ubiquitous systems robs us of some of our faculties, it may also cause us to lose faith in the ones that remain. We will find that [ubiquitous computing systems] are subtly normative, even prescriptive – and [...] this will be something that is engineered into it at a deep level"*[5]

My argument throughout this paper is based on the assumption that ubiquitous computing systems within aged care should be tailored towards supplementing and augmenting faculties and facilities that are considered to have atrophied (physical movement, cognitive functions), and not impinge upon faculties and facilities that are still a functional, important, and trusted attribute to the elderly. The example here of aged care highlights the important role artificial agency plays in the broader employment of and the ethical considerations associated with ubiquitous computing systems.

Locating agency within ubiquitous computing systems

Before returning to the role and location of 'agency' within such intelligent systems, I would suggest that, in order to achieve the aims in the aged care scenarios I have outlined above, ubiquitous computing systems must be tailored to:

- Accommodate static and fixed user profiles within dynamically changing contexts by exhibiting an element of functional and automatic adaptability, flexibility, and the capacity for continuous learning. For example, ubiquitous computing systems must be able to support the use of different personal identities (personas) so that elderly users can facilitate seamless communication within a variety of everyday, health-care, familial, social, and cultural contexts, regardless of changes within the given system.
- Support communication and interaction with other human and non-human users in real-time in a range of useful settings, such as browsing the web, sharing static content, establishing or facilitating user-discussions, or developing new social projects.
- Gather, process, and interpret data from a range of input devices in the same way the user does (or in a way that is at least 'useful' to the user).
- Inform users, user-networks, and user-applications of new opportunities, occurrences of interest, and relevant context changes that might otherwise escape the attention of the interested parties.
- Provide and facilitate adequate automated support for off-line, disconnected use so elderly users may continue to interact and work with other users on the network asynchronously.
- Provide users and user-networks with an extensive selection of simple open-source tools and software, so that they may create, add, or change functionality as needed.

These are very big asks for any software application, yet the intelligent agents behind ubiquitous computing are expected to suture together a wide spectrum of information for elderly and often cognitively and physically frail users within a technologically complex environment in a way that should seem 'seamless'. However, for the user to be freed from the acts associated with the location, transportation, interpretation, and transformation of the information that sutures various 'user positions' and information-augmented applications together, ubiquitous computing devices must continuously access (and respond to) a range of network services to accomplish predefined user and/or agent tasks, *regardless of whether the human-knows that such access is taking place*. In other words, in order to enjoy the seamless integration ubiquitous computing promises, the elderly are asked to forego and re-assign certain levels of autonomy to agent technologies.

One immediate and important ethical question that must be addressed in any such consideration is, then, where does accountability and responsibility for autonomous agent decision and action lie? Agents, as their name suggests, should act on behalf of somebody and not of their own accord. Yet as these devices continue to become invisible, seamless, and backgrounded – the grail quest for ubiquitous computing systems – the familiar and tried boundaries that exist between human-user,

[5] Greenfield, Adam: Everyware: The dawning age of ubiquitous computing. 150.

network, intelligent agent, and computational technology continue to blur, bend, and disappear.

Through all manner of popular, news, industry, and research media we are becoming increasingly familiar with intelligent media output devices within aged care such as robotic aids, remote-sensor operated surveillance and tracking devices, self-monitoring medicinal inventory and stock control machines, personal portable devices, 'smart clothing' that incorporates wearable technologies or that is constructed of smart fabrics and fibres for the monitoring of bodily functions, and a range of micro technologies adapted for the 'smart room' or 'smart home' that assist mobility and enhance patient comfort. Yet as ubiquitous computing technologies and the intelligent agents behind them continue to interact with other ubiquitous computing technologies and agents, human-users, and the broader object-based environment in which they are located, new relationships and user-patterns will develop.

History has shown us that the introduction of new technologies into a given socio-cultural environment usually generates within that environment a degree of greater complexity, often resulting in an increasing array of new opportunities that, in turn, promote and enable the continued development and diffusion of ever newer technologies. Ubiquitous computing technologies are no different, and the introduction, development, and diffusion of these technologies suggests that, ultimately, the relationship between the human-user and ubiquitous computing technologies can only extend already existing (and already complex) techno-social arrangements. This should not be read as a reiteration of the theses of Technological Determinism, but rather, a suggestion that any relationships that come to exist between human-users and ubiquitous computing systems cannot be deemed entirely causal in its structure or outcomes – regardless of the centrality one or the other 'actor' plays in a given relationship (for example, the act of coding or programming on behalf of the human, the act of collation and filtering on behalf of the intelligent agent, or the subsequent action on behalf of a ubiquitous computing device), one cannot conclude that the *entire* enterprise is one of direct determination or competition on behalf of either. Ultimately, human and ubiquitous computing interaction will deliver a more complex environment that encompasses ever tighter degrees of interconnectedness between agents, human-users, digitised information, and the external object-based world, and designers of ubiquitous computing systems for the elderly carry the added burden of introducing complex technology to an environment that is often already very fragile.

We must also accept that as ubiquitous computing systems become increasingly capable of reconfiguring real-world objects and relations, they will inevitably start to impinge upon certain configurations that are valued within the human subject. This raises a range of important questions. For example, what happens when those values and attributes that have traditionally 'belonged' to the human subject (such as 'choice', 'uncertainty', or 'novelty') are deemed to be at odds with newly configured environments, economic incentives, and operational variables that constitute ubiquitous computing? A nightmare sci-fi scenario might see elderly users unable to opt out of a ubiquitous computing system without violating or voiding health insurance. Conversely, if the intelligent agents behind ubiquitous computing preference human values at the expense of their preferred initiatives or incentives, will their outputs be read as affecting the human-technology relationship for better or for worse? If an elderly user chooses to preference 'budget', for example, will the ubiquitous computing system exclude visiting computation agents representing 'better'? These examples, banal as they are, suggest that for an ethics of ubiquitous computing the foremost question that must be addressed concerns the implications that arise when computational intelligences provide agency within the object world of the biological human actor.

The first step in addressing this question is to develop a conceptual and discursive space in which claims regarding the 'success' of ubiquitous computing are not simply measured in terms of increased competency, effectiveness, proficiency, productivity, complexity, and so forth. We must remain cautious in determining 'success' in those innovations that propel the quest for a more 'efficient' form of human automation, and stand committed to the axiom that 'faster', 'closer', 'longer', 'finer' etc. does not necessarily secure a formula for wellbeing amongst human and non-human actors, and may do little, if anything, to assist the elderly. These are value-laden measures steadfastly focused on economic outcomes and concerns, and I argue that, instead, an evaluative position must be established in which ubiquitous computing technologies are able to convince us that they have a genuine utility value within existing and new human social relations. To this end, human-users *and* ubiquitous computing technologies must be capable of negotiating the relationship that exists between them. While such a negotiation is inherently political (and therefore,

inherently human-focused) the discussion must extend beyond analyses of human *engagement* with technological componentry, and into a conceptual space that qualifies human-technology relationships.

This leads me to suggest that the advantage of accounting for and accommodating 'agency' within ubiquitous computing systems is that it would allow us to recognise that the functional processes (for example, the processing of sensory input, subsequent computational decision-making, the creation, collation, and broadcasting of information, and the enunciation of ubiquitous computing action) can *also* be recognised as an act of communication, or discourse production. In order to address the computational decision-making and subsequent action behind ubiquitous computing as a discursive act, three distinct categorical levels can be identified in which intelligent agents are seen to supplement, supplant, or supersede human agency.

In the first instance, the intelligent agent supplements the human-user by providing high levels of aid to established cognitive processes and tasks. In this instance, the human user would retain control of the outcomes of a particular process, and the computational agents and ubiquitous computing technologies merely extend the scope or scale of the human-users decision-making, kinetic capabilities, or other facilities. In the second instance, the intelligent agent supplants existing processes and tasks, by making decisions according to predefined human mandates. Here, computational action could occur in absence of the human subject, but only insofar as the human had allowed such action to take place. And in the final instance, the intelligence would supersede certain human-based facilities by making decisions and undertaking actions autonomously and unbeknownst to the human. Here, the intelligent agents behind ubiquitous computing are left to act in complete absence of the human-subject, having been commissioned to act according to predefined, or newly emergent and self-defined goals.

One implication that can be drawn from the relinquishing of agency to computation intelligences and ubiquitous devices is that the human-user can no longer be constituted or accepted as *the* most dominant actor/producer of subjective decisions. Agency and action, in this regard, can be related to existing power-knowledge nexuses that exist within human-technology relations. Within ubiquitous computing systems, agency and action can be seen as a defining force that positions, constitutes, represents, sustains, empowers – or prohibits – both its human and non-human subjects. Nevertheless, relocated to a computational intelligence, agency becomes amenable to technological interference and manipulation, reorganising, reformulating, and recontextualising embodied action according to the machine-based laws of the system in it is represented. As suggested above, such actions could have very real effects upon the actual and embodied human subject for whom the agent acts, and any accidental or malignant manipulation, partial or incomplete representation, or misrepresentation of agency may alter the direction, flow, or effect of subsequent action. As seamless as the computational functions of a ubiquitous system may seem, the subsequent results within the object world, and the impact these may have upon the lives of the elderly remain important considerations for designers of ubiquitous computing systems.

Conclusion

I have argued that in order to accommodate agency within ubiquitous computing, intelligent agents and agent operations must be contextualised within a broader conceptual discursive space. This suggests that if the diffusion and adoption of ubiquitous computing is to be negotiated in light of the outcomes that add favourably to human-technology relationships, then the shared history and culture of humans and technology must ultimately contribute to such negotiations. It can be argued that every new instance or application of ubiquitous computing effectively increases human-technology communication. That is to say, the action and interaction of human-users, ubiquitous computing technologies and devices, the intelligent agents that facilitate ubiquitous computing actions, and the operational environments (informational or object-world based) in which these actions are based would result in the production of new communicative, or 'discursive' arrangements.

I have suggested that the first step in evaluating ubiquitous computing beyond the socio-economic measures that are usually employed in discussion of technological 'success' is to develop a sustained and negotiated dialogue in which both ubiquitous computing and human actors participate. To this end, code structures that draw on established symbolic and semiotic representations should be erected in order to distinguish and differentiate between the biological, the social, and the technological. These should be configured in order to provide a structure of governance with clear and universally applied definitions and guidelines regarding the obligations

and requirements of both humans and ubiquitous computational technologies, in the form of protocols, guidelines, policies, and laws. Existing examples of such governmental structures already employed within computational industries include the structures and laws surrounding digital surveillance, encryption, information filtering, and client authentication.

While the example of aged care has been used within this document to locate and discuss the role agency plays within ubiquitous computing systems, the issues that have been raised suggest that agency is something that cannot be traded without serious consideration of the associated ethics.

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