An Emerging Tool Kit for Attaining Informed Consent in UbiComp

Abstract
Existing approaches to attaining informed consent are outdated and inappropriate for use in ubiquitous computing systems. The pervasiveness of the technology and the nature of user interaction require a rethinking of consent mechanisms. In this paper we briefly introduce and discuss several new approaches to consent acquisition developed specifically for the new era of ubiquitous computing.

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K.4.1 [Computer and Society]: Public Policy Issues - Ethics

Introduction
When interacting with computer systems, users have a justifiable expectation to have a choice with respect to both their agency and privacy. There are many technological mechanisms in place which facilitate this, although none more ubiquitous than the infamous check-to-agree-box [1].
As technology advances, we are approaching the ubiquitous-era of computing (UbiComp), which sees technology literally pervade every aspect of our lives [9]; a consequence of developments, and reductions in cost, in embedded, mobile and sensory technologies. This technology stands to fundamentally change the way we interact with, and perceive, computers. With an anticipated increase in the number of personal computing devices, we will see significant changes to the types, and amount, of information that will be collected, analyzed and autonomously enacted upon.

This presents users with a new type of interactional experience, and raises important questions about the acquisition, and even meaning, of consent. The current consensus is to simply apply existing approaches to attaining consent e.g. check boxes. However, these approaches have been argued as unsuitable and inappropriate for use within the context of UbiComp [4]. This is predominately due to their focus on a single moment of consent, which is a concept that seems out of place in large scale, dynamic, real-time and complex information systems. Hence there is a strong need to reconsider both the concept and application of consent in UbiComp [4].

Consent Mechanisms
Researchers have begun to explore a variety of different approaches to achieve informed consent in UbiComp. In this paper, we present a number of different examples of consent mechanisms, each focusing on informing through educating, different media and design frameworks.

Envision and Educate
One of the major problems faced by users of pervasive computing is the fact that many aspects of the systems will be embedded and hidden from view. For many, this concept will be very different to their current understanding of technology and, arguably, undermines the competence they can bring to bear when consenting. As with any future or emerging technologies, it is difficult/impossible to give users sufficient time to interact and familiarize themselves with it [7]. For this reason researchers have adopted an envisionment approach, whereby low-fidelity prototypes/mock-ups are developed to allow an approximation of real usage of the technology. However, this approach cannot give a user a sense of complete and large scale pervasive systems [8]. To meet this challenge, researchers have used a drawing envisionment technique where a narrated, animated sketch informed users about the future possibilities of technology in large scale energy systems (see Figure 1). Through this technique, participants better understood the types of choices available to them, the implications of these choices, and were then able to respond in an informed way [8].

Given that this techniques function is to inform, it could be adopted as an engaging approach to support consent within complex pervasive systems. Visually explaining complex information trajectories, consequences of actions and a users role/place in a wider system. This could serve as a mechanism for better informing users about the choices and actions they make within the wider context of a complex system. Unfortunately, whilst engaging, the limitations of this approach are that it is not easily scalable or necessarily able to capture the dynamism of the techn-
Technology as a Facilitator and Assessor

The mass-scale adoption of smartphones, currently a dominant example of pervasive computing, is likely to remain a focal point of interaction in the future. Given their anticipated ubiquity, one approach to acquiring informed consent could be to use these phones as a gateway to larger systems. This technology could allow today’s point of consent model to continue to be practiced in pervasive systems. This would be achieved by requesting consent from users at (socially) opportune moments through their mobile phone, when there is a notable change within a system [5].

One of the problems with this approach is that given the multitude of adaptive systems, the opportune moments for consent are likely to be fewer than would be necessary. For example, consent is likely to be required for data use within each changing context. If multiple systems sought consent each time data was collected or put to a new use, then the resulting number of alerts would be overwhelming. Arguably, such an approach would further exacerbate the current issues of low user attention at the point of consent, thereby undermining both informing and comprehension. However, the approach may be useful in specific intermittent situations.

Another salient approach currently being explored is the ways in which technology can help manage and assess the content of a consent proposition. Current research has explored how the SMOG (Simple Measure of Gobbledygook) measure of text complexity can be used to assess whether terms and conditions can be understood by their readers [3]. By using this algorithm it is possible to support those creating consent proposi-
tions to make them more readable and accessible (see Figure 2). A similar approach has also been developed to visualize such documents [2] and this has been automated.

Patterns of Consent
One of the major problems for informed consent in UbiComp is the unfounded complexity of interaction and information exchange/processing. Even in light of a series of newly identified mechanisms, an envisaged difficulty is knowing which to apply and when. This will become an important consideration when interacting simultaneously with multiple, adaptive and always-on computer systems. One proposed solution is to adopt a 'patterns' view of UbiComp systems [6].

This involves operationalising a complex system into core patterns of interactional arrangement. These patterns are simplified ways of describing the interacting components of a system e.g. humans interacting with multiple agents (see Figure 3). These systems are made up of repeating patterns, and as such can be categorised (e.g. see Figure 3 blue and green). If we can identify an appropriate consent mechanism for each type of core pattern [6], we can more easily make an informed decision on which approach to adopt. Furthermore, as systems are made of multiple patterns we are likely to see multiple consent mechanisms used together across what can be described as 'consent trajectories'. One of the limitations of this framework, is that it is still in relative infancy and has yet to be validated. The core patterns also need further refinement in their definition, and as the list is not exhaustive, there are other interactional arrangements to be identified.

Discussion
The advantages of the emerging toolkit are its focus on educating and informing users. It recognizes the agency of the users, and acknowledges their role within UbiComp systems; each tool/mechanism frames the user as an empowered entity. Though there are risks of placing too much emphasis on the users for determining their own affairs. Each user has a different skill set and ability to understand future technologies, meaning they have a different threshold for when they can be deemed adequately informed. However, the tools presented in this paper have scope for providing dynamic content, for example, by allowing the provision of more comprehensive descriptions on how the technology works to technical users, whilst having simpler framings for non-technical users.

Considering the practical uses of the envisionment mechanisms raises a number of questions. For example, when would be the best moment to present the user with the narrative? This is a similar problem faced by the notifications mechanism, and as such may benefit from the same solution: use of the Contextual Factors of Interruptions model [5]. This model predicts the most opportune moment to present users with information, based on local contextual factors. Another, perhaps more serious question is how to know at what point a user is fully informed by the envisionment?
Further formalizing of the toolkit could create harmonization across systems, for example creating a standard for envisioning narratives depending on the type of system, data collected and experience of the user. The next step would be to provide the user with mechanisms that increase the granularity of their consent, so once they are informed, they can actually change how the system functions in easier ways - e.g. opt out of certain data processing, or turn off functionality of the system that requires more data than they are comfortable to hand over. The mobile notification mechanisms would provide a useful platform for this. Finally, knowing which UbiComp system designs (and interactions across them) are best suited to different combinations of these mechanisms could be achieved using the patterns framework. Further development of the mechanisms outlined in this paper, and others currently in development, will eventually be brought together to form a toolkit for to support practitioners in attaining informed consent in their UbiComp designs.

Conclusions
In this paper we discuss the limitations of applying existing approaches to acquiring consent to UbiComp systems. Following this, we introduce a series of newly developed mechanisms designed specifically with this new technology in mind. Through these approaches, and others currently in development, a toolkit starts to emerge. This could support designers of UbiComp systems to more effectively and appropriately acquire informed consent from users of their systems.

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References