

The New Usability: The challenge of designing for pervasive computing

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Abstract

This paper¹ proposes the idea of *new usability*. It suggests that a radically new approach is required to address usability for emerging technologies. The paper suggests that new usability must emerge from a fundamental reassessment of existing methods, theories and tools to arrive at an approach that is suitable to a dynamic environment characterised by dramatically shortened product timescales, immense growth centred around the explosion of digital media content, a move toward mass consumer markets, pervasive access to information and communications and the global digital trading of knowledge-based products and services.

Keywords: Usability, appliance computing, new media, usability evaluation, interactive channels, pervasive computing, interactive TV.

Introduction

“As new technologies penetrate our lives at an increasing rate, we no longer know what functionality to expect from our refrigerator, our television, our car, our heating control system, and so forth. There is a trend towards product integration and we see an increased complexity of especially domestic technology. Thus, our expectations become challenged in the meeting with new products and they are formed and modified as we gain experiences with using the new technology. This exploration does not stop after the first hours or day of use. Our use continuously develops over time, new possibilities emerge and others fade away. Unfortunately, present usability engineering methodologies provide little support in understanding how use develops right from the first meeting with the whole product till we later discover small facets of the technology and more importantly how this development in use may be supported by the design of the technology.” [5]

After a quarter of a century of human-computer interaction research, usability engineering is well established. There are recognised career structures, national and international professional societies, regular conferences, university degrees and courses, through to popular books.

Building on research in the cognitive-psychological characteristics of users, the human factors of specific hardware and software solutions, and studies of technologies-in-use, usability engineering has matured to generate outcomes with real commercial value to organisations developing a broad range of consumer and business technologies. Usability engineering is the applied side of HCI, and aims not just to understand interaction issues, but to change practice, improve effectiveness, reduce error, and so on, in real systems.

There are now many competing usability engineering methodologies, a variety of usability engineering tools and development environments, and many providers of usability services. Most methodologies are designed to work within the limitations of the real world — lack of resources, lack of time, or market pressures.

¹ This paper is an expanded and revised version of the editorial to the special issue of *ACM Transactions on Computer Human Interaction* (TOCHI) ‘The New Usability,’ to be published in 2002.

Despite the great variety of methods, within the usability engineering movement the concept of testing and evaluation is fundamental. Testing the usability of a product provides measurable and actionable knowledge, which can be used to improve design outcomes. So successful has the usability engineering movement been that dedicated testing facilities have been developed, usually in the form of usability laboratories that provide a controlled environment in which to study and test products.

The popularity of the usability testing facility has spawned a set of related businesses including those developing and supplying testing tools (video and audio capture, logging and analysis environments), and those providing specialist consulting services in usability testing.

To all intents and purposes, usability engineering and usability testing has now reached the stage of a mature industry with a stable set of objectives, processes and common knowledge. Usability is now accepted as a fundamental activity, many organisations have well-established usability functions, and usability has been productised to assist companies in making a differentiated customer offering in a fiercely competitive technology marketplace.

A changing environment

However, the technological, social and commercial environment has changed dramatically in the years since, say, Jacob Nielsen reviewed the state of the art in usability laboratories in a special issue of the UK journal *Behaviour and Information Technology* [6].

In an environment where information technologies are treated as commodities, usability is of course a key factor in a product's success, and consumer expectations are that products will have usability engineered-in. Initiatives in the UK such as the highly visible Department of Trade and Industry's *Usability Now!* in the late 1980s, and projects funded under the government EPSRC research council's Human Factors programme, have served to contribute to this maturity.

The New Usability

The object of usability engineering — which has matured and gained its character against a background of office-based personal computer applications — has dramatically changed. Whilst usability engineering is an important discipline, with an increasing role to play, it is not sufficient. We need, too, a new usability: there are new developments in technologies and markets, which cannot be addressed by conventional usability methodologies.

Far from being only a key issue in the design of workplace (typically console and desktop computer-based software applications and office-based peripherals and devices), usability is now a central issue in the design of a vast range of technologies, particularly handheld and mobile personal systems used away from the organisation, and in new application scenarios, particularly internet-based e-commerce applications accessed from the home and the community. The rise of pervasive computing — anytime, everywhere accessible information and communications — presents technologies, applications and business contexts which mean that established usability engineering methodologies have become increasingly out of date.

For example, the *appliance computing* paradigm [3][7] presents immense challenges for traditional usability approaches.

What appliances represent is how computers (that is, embedded computers, not desktop computers) are finding their way back towards being things that fit our physical, embodied natures, rather than only operating in the realm of symbolic processing. This means designing information products around *human* inputs and outputs rather than business, informational, computer-centric ones. A corollary is that all the devices such as cameras, printers, speakers or microphones that were formerly considered 'peripheral' must become central in the design process. For an approach such as usability engineering — which matured and gained its character against a background of office-based personal computer applications — this presents considerable challenges.

This tension was also recognised some years ago when the usability issues in game playing were recognised as a distinct from workplace usability issues [8]. In games playing, users are discretionary: they revel in set-backs, frustration and problem solving; complexity and unpredictability are good; it is often the case that widespread carnage is good; in social games, users typically compete. In contrast, in the workplace users have little choice, and are required to

perform: here set-backs, frustration and problem solving are stressful; complexity and unpredictability are bad; widespread carnage must be avoided at all costs; users must co-operate. Despite the superficial similarities, such as frustration and error caused by system design, the usability differences are extreme. In the workplace, all users who fail reduce productivity, and so their usability needs are important; in contrast, for consumer products such as games, most users who would fail don't even use the technology at all — they are, at best, *not yet* users, as opposed to inefficient users. These users can walk away. In conventional usability, we might be concerned about individual differences — how to design to cater for people being different. The New Usability may well be interested in designing specifically for certain sorts of personality. In this sort of usability, we are interested in the successful users, not the users who don't use the system well or at all.

Usability, in the widest sense, is becoming a central issue in the design of a vast range of technologies — particularly handheld and mobile personal systems used away from the office — and in new application scenarios, particularly internet-based e-commerce applications accessed from the home and the community. Yet usability as conventional usability engineering is becoming less and less relevant.

A reasonable expectation on the part of consumers is that new generations of products — such as information appliances — will be able to benefit from the knowledge developed in the usability community, and that well-established approaches such as usability testing will be of immediate relevance. But this is clearly not the case. For example, how is it possible to 'usability test' an appliance which is based around new design requirements such as 'ambience' or 'attention'? Most usability testing regimes assume the context of a person facing a computer, the luxury of the person's full attention, a comfortable environment, and with minimal distractions — indeed features that typify work environments. Information appliances on the other hand, need to work in low-attention situations, or where the user's attention needs to be fleetingly channelled through the appliance — while walking, talking, or any of the multitude of other day-to-day activities that would be routinely classed as 'distractions.' Rather than being 'edited out' of the context as they are in the usability laboratory, these features must be at the centre of understanding and designing these technologies[9].

Businesses are struggling with unwieldy and complex usability techniques in environments where the usability engineering issues are increasingly demanding and complex, since emerging systems and applications have a broader user base, a wider range of uses, and more demanding user expectations. The place of 'the user' is increasingly being taken by 'the consumer,' and the existing usability paradigm is unable to handle such a complex and multifaceted definition.

Dramatically shortened product timescales, immense growth centred around the explosion of digital media content, a move toward mass consumer markets, the global digital trading of knowledge-based products and services: all have created a reorganisation in the value network for Information Technology and Communication industries, with the result that communications and computing products will be selected for their ability to deal with the latest content in a highly usable fashion.

This means that usability is of key strategic importance in product design, and companies are seeking a New Usability that will be far more successful in creating highly usable products and services than is possible by attempting to apply the existing paradigm.

Key questions

This key issue — the discontinuity between emerging technologies and applications and the current usability engineering and testing paradigm — is one we suggest will be the defining one for a new usability engineering in the next few years. The key questions that must be answered are:

- what is now the role of usability testing and its relationship to usability inspection and usability enquiry in formulating usability engineering methodologies and tools that can be successfully applied to emerging technologies and applications?
- what new usability engineering and testing methodologies are required to allow the creation of highly-usable technologies and applications for future information appliances and environments?

Such questions are especially pertinent for growth areas such as the following

- Interactive TV
- Mobile and Personal systems
- Pervasive computing
- Embedded computing applications
- Ubiquitous and context-aware computing
- Domestic computing technologies
- Internet appliances

The drivers for new usability are not users' performance within an organisation, but larger issues. If consumers do not like a product, they discard it and buy another one. At a micro-level, this puts economic pressure on business to make products usable [1]; at a macro level, the waste of discarded products creates environmental pressure [10].

An example: Interactive TV

A prime example where the new usability is urgently needed is in the area of Interactive Television (iTV).

Here there are no established guidelines for design. Even if platform providers were to turn to the literature on internet, web and on-line design, it is not whether such design conventions will be appropriate for iTV.

Although it might seem most applicable, the huge literature on web design is a disappointing mix of design prejudice and conventional usability aimed at improvement of the user experience through desktop browsers — and mostly driven by the priorities of e-commerce. The failure of WAP is a clear indictment of conventional thinking. Even if with hindsight we think that WAP failed because of conventional usability problems, why did industry ignore the usability professionals at the time? Simply, because conventional usability was irrelevant to the appliance's needs: it was not ready, and could not provide justifiable, influential and effective arguments in time.

The highly interactive nature of iTV services [4], the essentially domestic nature of the application, the diversity of expertise and expectation in the user population and the variety of interaction devices which may be used (remote handset, wirefree keyboard, special-purpose controller) suggests that existing approaches focusing on the details of any single established interaction device will be inadequate. Not only this but the 'lean-back' experience offered by interactive TV is very different to the 'lean-forward' one of the PC environment. Factors such as *viewing distance* (the PC is optimised for a single viewer at 18–30 inches from the screen, the TV for a group of viewers several feet away), *resolution* (PC displays easily exceed the resolution of even HDTV displays), *customisation* (the PC is typically customised by its user but the TV screen is a one-size fits all device) and *viewing area* (TVs cover a small portion of our field of view whereas PCs cover a larger one) are all critically different for interactive TV.

A more complex set of issues emerge from the challenge of how to place design for usability in the context of the new business models. The following models, discussed in [2], all have very different implications for design for usability in interactive TV:

- *Subscription TV*: users subscribe to a variety of channels — digital cable and satellite pay TV were responsible for the accelerated development of interactive TV in Asia, Europe and North America.
- *Interactive TV (iTV)*: cable pay networks, followed quickly by satellite operators, have developed a variety of basic interactive TV services, particularly walled-garden interactive services.

- *Video-on-demand (VOD)*: where users can view programmes on demand — US analogue networks have long hosted systems that provide interactivity this kind of interactivity.
- *Near video-on-demand (NVOD)*: providing users to staggered scheduled of programmes by the use of bandwidth efficiency enhancers.
- *Impulse pay-per-view (IPPV)*: in the early days of pay-per-view the telephone played a key role. A number appears on the screen. Viewers close the loop and acquire the entitlement to watch a film by calling a call centre and using the keys of their phone to interact with the commerce system.
- *T-commerce*: users can now interact with shows online and buy products through their TV set.
- *Transaction TV*: which provides the ability for users, wherever they are, whenever they want, whatever they are watching, to be able to use a remote control to buy products.

As technology evolves, as new opportunities for content and services suggest themselves, and as the user population's level of expertise and expectation rises, designers will be increasingly faced with the problem of where to turn for knowledge about how to design effective and usable services. They may well turn to existing human factors guidelines and methods which will prove inapplicable to such radically different technology and user models; they may also look to emerging knowledge of internet services design which, whilst sharing some of the same characteristics, is of an essentially different character to iTV.

The likelihood is however, that designers will develop a mix of ad hoc, in-house standards for design, many of which are incompatible, lack coherence, and are founded on the human factors and cognitive science knowledge which has been generated on the basis of a now-outdated economic, social and technological environment.

Conclusions

It is in areas such information appliances, exemplified by iTV, where we suggest that the New Usability will be defined and will have the most impact.

The New Usability challenge is therefore how to respond — quickly — to emerging technologies and applications. This is an incredibly important issue, and both the importance and urgency need to be understood as a matter of priority.

We can't take it on trust that the new usability will automatically be better: it will have to be worked at, and this in itself creates its own problems that will have to be surmounted. The professional community advances its field through conferences and publications, and of course academic publications. New Usability requires a new examination at what is good work, and what is publishable. The old criteria are too narrow. How can we advance the new usability without writing what would be dismissed because of poor evaluation and inadequate controls? How can we advance the new usability without writing what would be dismissed as product reviews? The answer is: the new usability is an attitude that will have to pervade all aspects of the profession, else we won't hear about it further, and it will have no useful impact.

If a New Usability which embodies these understandings is not driven forward, then we face the situation where usability as currently defined will be increasingly marginalized and consumers will be the recipients of badly-designed, inefficient and ultimately unusable products and services.

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