

Augmenting the lives of older people with pervasive computing: phones, robots, rabbits, dogs and older people.

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Workshop on:

Technologies for Health, Rehabilitation and
Self Management of Long Term Conditions
30 June 2008. University of Bath.



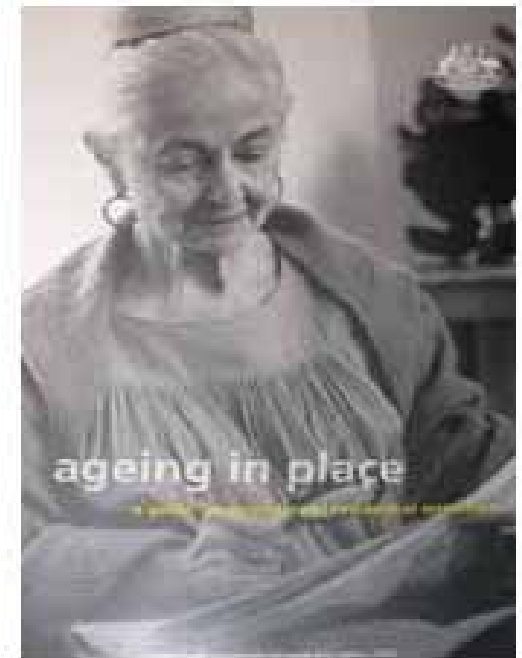
Ageing in place

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- Maintaining an independent lifestyle, and living in their own homes – ageing-in-place - is often an integral social need of many older people and could also have direct cost benefits for the full-time care sector.
- There is also evidence to suggest that older people are healthier and report a genuinely higher quality-of-life if they remain independent*.
- However, independence can, at times, lead to vulnerability and this can also put increased demands on other sectors of the healthcare sector as well as on supporting families and other caregivers.
- Deterioration in older people in areas such as cognitive ability, memory, and physical dexterity lead to concerns around such issues as the neglect of nutrition and medication, physical well being (falls) and social isolation.



*Lawton (1982) M. P. Competence, environmental press, and the adaptation of older people. In M. P. Lawton, P. G. Windley, & T. O. Byerts (Eds.), *Aging and the environment: Theoretical approaches* (pp. 5–16). New York: Springer.

Intille's agenda

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- A recent research agenda to develop persuasive computing systems to support healthy ageing has been put forward by Stephen Intille (2004).
- This agenda concluded that current research effort should be directed at exploiting **emerging consumer electronics** to “motivate healthy behaviour as people age by presenting **just-in-time information** at points of decision and behaviour”.
- Autonomous, and intelligent assistive systems which support independent living by providing **reminders** and other pertinent information that can assist in decision-making processes have the potential to make a significant positive impact on the lives of older people and their care-givers (Pollack 2005).
- However, to-date, the requirements of such autonomous systems, and particularly their interface, cognitive impact and social acceptability to older users is not well understood.

Intille S.S. (2004). A new research challenge: persuasive technology to motivate healthy aging. IEEE Transactions on Information Technology in Biomedicine (Special issue on Pervasive Healthcare), 8 (3) pp. 235-236.

Pollack, M. E. (2005) Intelligent Technology for an Aging Population: The Use of AI to Assist Elders with Cognitive Impairment," AI Magazine, 26(2):9-24.

Chuck technology at it!

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- Despite this, a striking number of “smart” homes have appeared in recent years which are aimed specifically at the deployment and evaluation of **context-aware** and **pervasive computing** to support ageing-in-place.
- Many such demonstrators have been built around conventional houses where the walls, floors and **appliances** are used as displays and/or input.
- A number of groups are also exploring the use of ‘traditional’ augmented reality (AR) technologies within the home, such as in the ‘kitchen-of-the-future’ scenarios (such as at **MIT** on right) or by deploying numbers of smaller devices to form distributed displays (Siio et al 2004).



Persuasive technology

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“My mother lives 1200 miles away. I used to call her twice a day to make sure she had taken her medicine. Now I don't have to worry.”

a happy client of e-pill Medication Reminders_ – see <http://www.epill.com/>

- Intille reasoned that message should be given – “ (at) a point of decision or behaviour where when an easy to understand message might have an impact on **behaviour**”.
- There are now many recent studies showing that technology can indeed have a **persuasive** & positive effect on user behaviour (Fogg 1998).
- These include the development of active-medicine bottles, specialized reminder/memory aids and even systems to give us reminders about almost everything to do with our daily-lifestyle (Czerwinski 2006).



Memento by Jason Nawn at MIT (2004)

Fogg B. J. (1998) Persuasive Computers: Perspectives and Research Directions. Proc of ACM CHI 1998: 225-232.

Czerwinski, M., Gage, D., Gemmel, J., Marshall, C. C., Perez-Quinones, M., Skeels, M. M., et al. (2006) Digital memories in an era of ubiquitous computing and abundant storage. Communications of the ACM, Special Issue on Personal Information Management, 49(1), 44-50.

Acceptability of technology?

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- Some researchers refer to such developments as **cognitive orthotics**, though such a term has previously only generally been applied to devices developed for people with severely impaired memory function.
- Many of the systems described above are still very much in their infancy and much has to be learned about their efficacy as well as their **acceptability** by older people.
- Emerging technologies such as AR could, in future, provide an ideal medium for persuasive messaging – however at present we are wary of adopting such technology as a platform to build experimental systems for reasons of cost and also sheer strangeness and novelty, in a home setting.
- In our research we are striving towards systems which do not intrude into older peoples' everyday lives but provide flexible and socially acceptable persuasive messaging and which assist with an everyday activity in an effective manner.



What we did with SPARC



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Our goal was to exploit consumer electronics to provide real-time cues to older people in a simulated home setting. We set about this as follows:

- gather information about older peoples' perceptions of technology in general
- identify scenarios where autonomous reminder techniques might be helpful
- implement a variety of simple systems based on everyday technology. These should deliver reminders that are (a) non-intrusive and (b) persuasive
- apply these technologies to the scenarios and devise “Wizard of Oz” experiments* to explore older peoples' perceptions of these hybrid technologies and consequently identify a framework that can be used as a starting point for further research.



*Maulsby, D., Greenberg, S. and Mander R. (1993) “Prototyping an intelligent agent through Wizard of Oz” in *ACM SIGCHI Conference on Human Factors in Computing Systems*, pp277-284, May 1993.

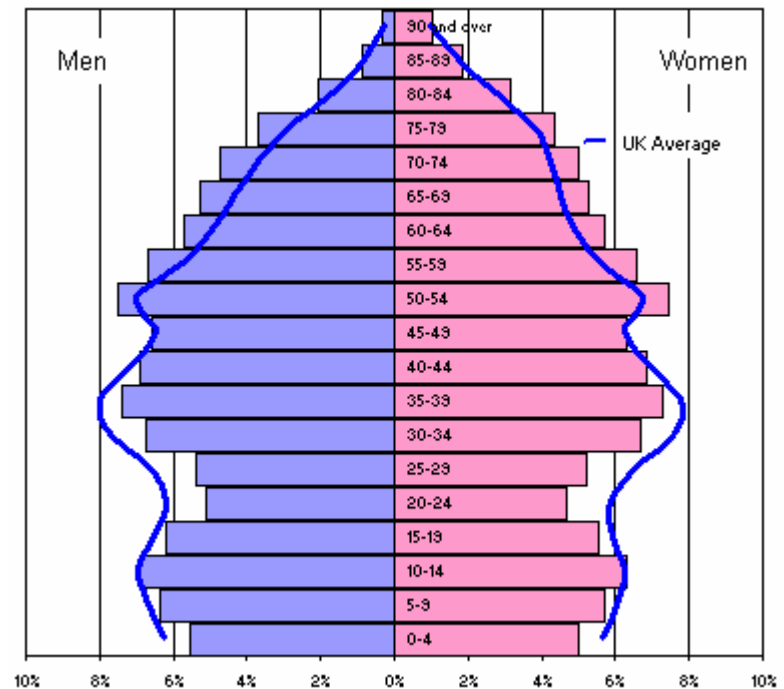
Interviews in Lincolnshire

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- We invited participants to the University campus or visited them in public environments such as the local Age Concern centre in Lincoln.
- Originally we designed an in-depth questionnaire for assessing people's attitudes to technology but after a short period of testing, this proved too prescriptive for our needs.
- We therefore went on to develop a structured interview approach.
- We particularly wanted to determine older people's attitudes to the notion that the technology around them could be used to provide reminders and prompts but were also keen to see if people's backgrounds and social-economic status also affected their views on technology.



Population Pyramid for Lincolnshire from UK Census 2001

<http://www.statistics.gov.uk/census2001/pyramids/pages/32.asp>

Example comments

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Participant X -

1. ``I had a little trouble with it [a video recorder] --- as a new thing''
2. ``I can't hear the phone in the kitchen, so I was offered something on the wall [a strobe] that flashed. I said "wouldn't it be better if I had a cordless phone" ``
3. ``It [the remote control] looked a bit complicated to me....[I prefer] anything that's not too complicated''

Participant Y -

1. ``I've had it [an old mobile phone] given to me - a cast off from my children''
2. Would you actively avoid buying one [a mobile phone] with more features (cameras) ``Yes, as they're more expensive...I wouldn't mind experimenting with them if it wasn't so expensive''

Participant Z -

1. ``[Devices don't annoy me] once they're set up. It's getting them to work in the first place!''
2. (on call centres and mechanistic technology in general) ``Even people who know the technology under certain circumstances want to talk to someone...a problem is lack of training for people on the end of the phone - they've got a script and if you ask a question off the script they don't have a clue what you're talking about''
3. ``If it [the phone] is flashing for no reason it doesn't seem important''
4. ``My wife writes them [appointments etc] down so I don't have to, really''

Interview findings₁

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- The interview scripts were manually analysed - impressions in the following categories were coded:-
 - Technology use
 - Technology attitude
 - Interest/aspiration
 - Useful metaphors (e.g. from existing reminder techniques)
- Participants often used technology that had been primarily bought and setup by relatives. This technology was not always well received.
- Relatives also appeared to be the most common form of technical support, with participants unanimously complaining about the quality of manuals and the design of interfaces to the more complex products such as audio-visual products.
- Outside the home, the services that met with most approval were things like telephone banking, remote bill payment and suchlike. Only one participant said they actively tried to avoid such services.

Interview findings₂

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- No participants used the Internet as a matter of course, though some had used it, apparently on the instigation of relatives.
- Computer use was low, though some users also said they did some office productivity tasks such as producing newsletters.
- Even those with professional backgrounds reported little experience with desktop computers during their working life.
- This appears to confirm the findings of the **UTOPIA** study of older people in Scotland (Goodman et al 2003), though we would expect to see awareness of computers increase as time goes on as those people still in work will necessarily need to use computers and will retain that familiarity when they retire.
- No participants reported using interactive television services, despite all but one having access to digital TV, satellite or cable.
- Other interesting comments include the dislike for perceived misuse of technology - particularly mobile phones. Three participants had mobile phones “for emergencies only” and expressed disapproval of these being used in public places.

Interview findings₃

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- Participants expressed curiosity about various things including various premium mobile phone services, the internet and computers in general. However, none of them had plans to acquire any of this technology in the future which fits with the passive approach to technology acquisition they had.
- Aside from the useful information about what technology they preferred to use (phones) and what they did not (anything that appears “too complicated” in the words of one participant) the interview also discussed existing reminder strategies use by the participants with a view to allowing future research work to emulate some of these.
- Some participants reported relying on family to remind them of things, implying that a phone-call reminder type might be quite successful (as it proved to be in or experimental work).
- Some reported using diaries and calendars while others used various ad-hoc systems of note taking.
- One participant relied on memory alone.

Prototype System

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- Following our structured interview process, we then went on to develop a prototype 'living-room' system featuring a wireless network of typical home devices of telephone (both conventional and cordless), RF remote control device, analogue radio and TV.
- Through use of open-source software technologies and standards such as **Asterisk**, SIP and MPlayer we were able to program consumer devices* in such a way to allow them to behave like conventional consumer electronics, but also so that they could be interrupted to present synchronised persuasive messaging to a user.
- Four **scenarios** (given here) were developed in consultation with local care professionals to capture everyday behaviour. The scenarios were selected to script an experiment to evaluate older peoples' reactions to our system.

	Critical	Non-Critical
Time Dependent	Attend an appointment	Watch a particular television programme
Time Independent	Take medications	Water household plants

*Details on the technical implementation of the system can be found at <http://hemswell.lincoln.ac.uk/~slawson/SPARC/>

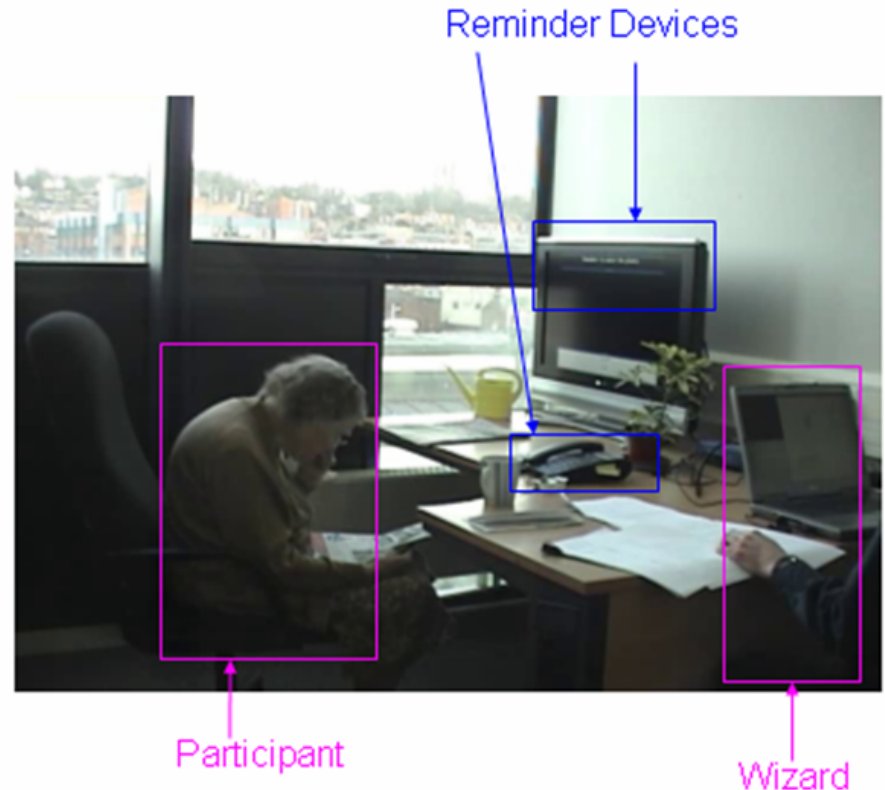
Experiments

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- We devised a **Wizard-of-Oz** experiment to evaluate older people's reactions to our system.
- Hence we utilized a human 'wizard' for real time analysis of user activity, and cueing of scripted visual and aural cues.
- The system was evaluated with eight recruited participants, some of whom previously completed our structured interview process.
- We defined "acceptable reminders for each scenario and an order of escalation, plus "success" & "failure" conditions. Subjects were not instructed in the use of the system though paper documentation was present and the use of the remote control explained. This simulated a system placed in the home without explicit instruction, as is the case with much commodity technology.



Experimental Findings₁

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- Context of reminder delivery was important and subjects reacted differently depending on what they were doing and the scenario the reminder(s) were used for.
- In almost every case the participants received and understood the reminder, but often required escalation or multiple attempts.
- Reminders were often noticed when reminders were in a different “mode” to the distraction task.
- On screen reminders when users were watching television was effective, but often only when the reminder had been repeated.
- The intrusive ringing phone reminder was felt to be irritating when used for a trivial task like reminding the user to watch television at a particular time. Nevertheless, they were effective in all cases too.
- The synthesised voice reminder was particularly popular and effective when received over the phone, indeed the clarity was commended by two participants. However, the same reminder but delivered over the loudspeaker system was thought to be unclear.

Experimental Findings₂

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- We believe this is because the ringing of the phone or the action of dialling voicemail focuses the user's attention appropriately and they are receptive when the message eventually arrives.
- In the case of the loudspeaker, they were not "primed" to receive the message and therefore do not always understand it.
- The voicemail system caused the most confusion, particularly in the case where a voicemail was left and the flashing telephone or single ring reminder types were used to alert the participant to its existence.
- Differences between participants' interpretations of the same reminder indicate a potential need to tailor such systems to the peculiarities and habits of the user for maximum effectiveness.
- This was tempting to do in the framework of the Wizard of Oz experiment but in a commercial system would need to be performed either by a technician of some sort or the user themselves.
- Further research is needed to identify ways of discovering user preferences without trial and error or overwhelming "options" screens.

Where we are.

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- We believe that, in the short term, there is a place for cognitive orthotic devices so long as they utilise cheap and familiar technology such as the type we deployed in our experimental work.
- As our project developed, the notion of harnessing the potential of Interactive TV (iTV) to support aging-in-place emerged and our experimental platform, unintentionally turned out to resemble this.
- To-date work in iTV for older people is a little limited* and this where we are currently steering. However we are also worried about the general concept of turning a TV into a central information appliance.
- More fundamental are issues raised in our interviews; for instance, who, in the future, will be responsible for buying and maintaining such systems as there was clear evidence that family and caregivers are taking a dominant role in this – indeed we’ve recently returned to making ever more general interviews to explore older people’s attitudes to technology

*though see the work of Mark Rice at Dundee in, for instance who is looking to exploit iTV for social networking for older people); work done as part of The Application Home Initiative (TAHI) at Loughborough; work by Marianna Obrist at Salzburg; and the Philips Motiva tele-health system.

Robots

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- The award of a SPARC grant has opened up many new doors to us and has enabled us to rethink many areas of our existing research in pervasive computing and human computer interaction.
- One area we were already working in at Lincoln – with funding from Microsoft Research Cambridge – was Human Robot Interaction (HRI).
- It seems inevitable that robots, before long, will be widely present in everyday human environments - however the general population will have no idea how to interact with such robots*.
- Our reasoning is that robots will have to communicate intention, interrupt people, or get their attention, but they should **also** remain empathetic, easy to forgive, non-threatening, or even fun and playful.
- Most importantly, humans should not have to learn the peculiarities of each robot they might encounter.



* figure on this slide is the album artwork for Yoshimi Battles the Pink Robots, by The Flaming Lips (2002)

Robots ... and dogs

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- Dogs, because of their close association with us, have recently been shown to be extremely important animals in terms of studying human behaviour and evolution - additionally they possess a unique understanding of human social, physiological and behavioural cues.
- Dogs represent great models for human-interactive robots that we are all able to work with, understand and respond to.
- We've been working with animal behaviour scientists in making modified **Roomba** robots behave in dog-like ways* - and we 're now beginning to make the distinction between older and younger people in these studies – indeed its often predicted (though sometime also highly disputed) that robots have a big future role to play in the lives of older people.



More dogs

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- There is mounting evidence to suggest that dogs can, very reliably, predict the onset of a seizure in their **epileptic** owners.
- It is currently unclear as to exactly how dogs recognise pre-seizure conditions, though work to date indicates that they rely primarily on visual cues such as facial expressions, postures and general behaviour as opposed, for example, to olfactory and auditory cues.
- My own interest is in how we can use dogs' extraordinary abilities in these areas to build better artificial systems in general and human/machine interfaces in particular.
- As a start to this work, we are working alongside animal behaviour scientists and dog trainers to look at **hypoglycaemic** alerting in pet dogs – this work is currently funded by **Diabetes UK**.



And ... rabbits?

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- Achieving a better understanding of, as well as developing the means to improve, social communication between generations is an increasingly important goal.
- A small project we have ongoing aims to design, build and evaluate a prototype of an, ultimately, inexpensive robotic device utilizing smartphone technology – (which we term a **phobot**) - which facilitates social communication between young people comfortable with using mobile devices and social networking tools and service, and older people who have little or no experience of even desktop computers, nor the technical knowledge or financial means to purchase such systems.
- Our vision is to create a robotic companion that older people can use as an engaging, useful, fun, accessible, and ambient interface to voice, SMS Text, IM, email or other custom messaging services that are used everyday by younger members of, for instance, their same family.



One more project ...

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- Lincolnshire County Council* are piloting a scheme in which will provide **Nintendo Wii** systems, together with specially developed resource packs, as “facilitating technology” relationships between older people and children in carefully staged workshops.
- There is much anecdotal evidence that older people “like playing the Wii” - but older people’s attitudes to technology in general – and games in particular – are not well understood in scientific terms.
- We are currently setting up trials to begin to answer some of the questions around older people and games – whilst the whole issue of inter-generational play is to-date pretty much unexplored as well.



*in fact there is an international wave of similar projects – Age Concern and Liverpool council are a little ahead of Lincolnshire for instance.

Thank you ...

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- Of course, to SPARC for the funding of the reminder based work. The researcher on this project was David Nutter and we also worked alongside Jane Dyas at the University of Nottingham on this.
- Microsoft Research Cambridge funded our recent work in human-robot interaction.
- Diabetes UK are funding our pilot study, headed up by Deborah Wells at Queens University Belfast, into dogs and hypoglycaemic alerting.
- Co-authors of the intergenerational “nabaztag” work are Prof Roger Orpwood, here at Bath, and Prof Gail Mountain at SHU.

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