HCI Issues Relating to Proactive and Adaptive Hypermedia based Systems

Proactive systems…

- When we use the term proactive, we agree with the understanding of the term presented by (Salovaara and Oulasvirta, 2004) :
  - "Proactive systems adhere to two premises: 1) working on behalf of, or pro, the user, and 2) acting on their own initiative."
- Oh dear – we're getting into the old 'can machines have initiative…' argument…

Salovaara, A. and A. Oulasvirta.: 2004. 'Six Modes of Proactive Resource Management: A User-Centric Typology For proactive Behaviors'. *Proceedings of the third Nordic conference on Human-computer interaction*, Tampere, Finland, ACM Press, pp. 57-60.

Background…

- Motivation…
  - Consider a proactive 'intelligent' system that is personalised to the user based on a learnt user model and is 'understandable' by the user…
  - Use the system to consider issues of:
    - *Comprehensibility*
      - *Explanations etc.*
    - *Scrutability*
    - *Control*

Comprehensibility

- A less 'overloaded' term than transparency (Jameson, 2004)
- He uses the term *comprehensibility* to suggest that the user:

  "…can look through the outer covering (e.g. a glass box) to examine the inner workings of the device."

Jameson, A., S. Baldes, M. Bauer and A. Kroner.: 2004, 'Resolving the tension between invisibility and transparency'. *Proceedings of 1st International Workshop on Invisible and Transparent Interfaces*, Gallipoli, Italy, pp 29-33.

Comprehensibility

- Concerning this need for comprehensibility, (Abowd and Mynatt, 2000) make similar comments when discussing key challenges in the ubicomp domain:

  "One fear of users is the lack of knowledge of what some computing system is doing, or that something is being done 'behind their backs'".

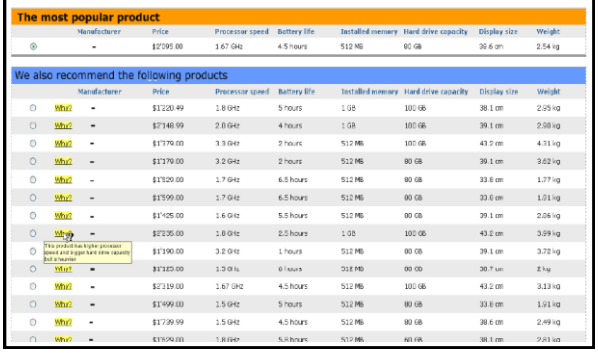
Abowd, G.D. and E. D. Mynatt.: 2000, 'Charting Past, Present and Future Research in Ubiquitous Computing'. *ACM Transactions on Computer-Human Interaction, Special Issue on HCI in the New Millenium*, **7**(1), 29-58.

Do you trust the agent??

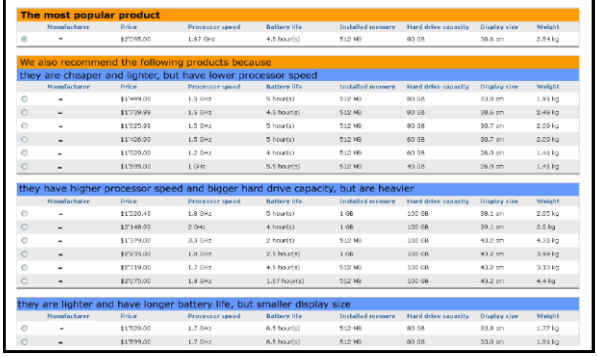
- Has been some work considering whether the user will trust the 'intelligent' agent more if the agent explains its decisions/behaviour,
  - e.g. Pu and Chen's work on recommender agents (Chen and Pu, 2006)
  - How does the user perceive the agent's competence?

Pearl Pu and Li Chen. Trust Building with Explanation Interfaces. In *Proceedings of the 11th International Conference on Intelligent User Interface (IUI'06)*, Sydney, Australia, Jan.-Feb. 2006.

Chen's "why" interface…



Chen's organization interface…



Scrutability

- But can interrupt if proactive…
- *Scrutability* refers to the ability of a user to interrogate her user model in order to understand the system's behaviour. In relation to ubicomp environments, (Kay *et al*., 2003) describe how:
- "...when the user wants to know why systems are performing as they are or what the user model believes about them, they should be able to scrutinise the model and the associated personalisation processes"
- But how does this affect the underlying learning approach that gives the system its 'intelligence'?

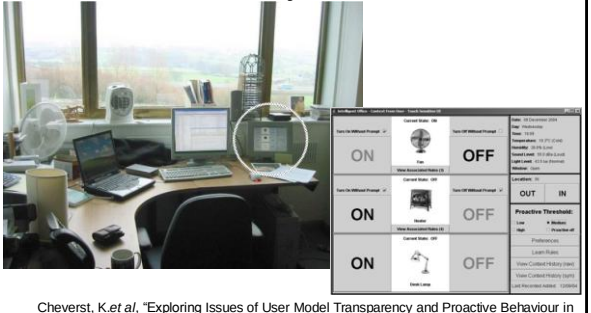
Kay, J., R.J. Kummerfeld, and P. Lauder: 2003. 'Managing Private User Models and Shared Personas'. *Proceedings of UM03 Workshop on User Modeling for Ubiquitous Computing*, Pittsburgh, USA, pp. 1-11.

Control

- Relating this back to the issue of control, (Kay et al, 2003) also state that:
- "...one of the important requirements of ubiquitous computing, [is] that of ensuring user control over the model"
- and
- "We see scrutability as a foundation for user control over personalization".

Kay, J., R.J. Kummerfeld, and P. Lauder: 2003. 'Managing Private User Models and Shared Personas'. *Proceedings of UM03 Workshop on User Modeling for Ubiquitous Computing*, Pittsburgh, USA, pp. 1-11.

IOS in my office…



Cheverst, K.*et al*, "Exploring Issues of User Model Transparency and Proactive Behaviour in an Office Environment Control System." Special Issue of UMUAI (User Modelling and User-Adapted Interaction) on User Modeling in Ubiquitous Computing, Kluwer, Volume 15, Numbers 3-4, Pages: 235 – 273, August 2005.

IOS Overview…

- Part of our original motivation was to determine whether it would be possible for context-history to be used to infer the nuances of a given user's behaviour.
  - For example, if considering the temperature inside an office, there may be numerous ways in which a user might attempt to cool the temperature.
    - She might open the door (if it is cooler outside),
    - close the blind (if strong sunlight is shining into the office),
    - turn on the fan (if she is not engaged in an activity where the noise of the fan would be distracting), o
    - pen a window (if it is not too noisy outside) etc.
  - Our hypothesis was that by having an appropriate set of sensors recording context such as office temperature, level of light, etc., that it would be possible for a system to learn the user's favoured approach for controlling the office temperature and then (to an extent acceptable to the user) automate the process, e.g. by turning on the fan.

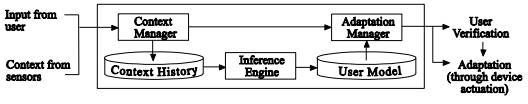
Context History/User Model…

- Uses context history in order to learn (infer) the patterns of the user's behaviour in his or her physical office environment.
- Support modelling-based proactive adaptations
  - (opening/closing the window, turning on/off the fan, etc) based on both the patterns learned
    - represented as a generalised set of rules
  - the state of the physical office environment
    - realised through a set of sensors
- The contexts considered in the experiment were: temperature, humidity, noise level, light level, the status of window, the status of fan and the location of a user.

Choice of learning approach…

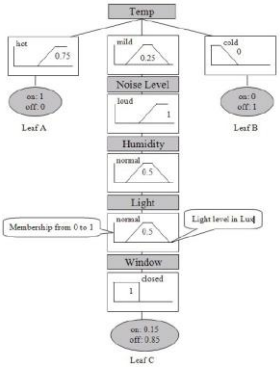
- But note that some (most) ML approaches don't produce meaningful/comprehensible results, e.g. nerual networks which just produce numerical weights by way of evidence…
- What we want are 'IF THENs'!
- Result – Use Decision Trees
- Allow user to see what's happening and override if they disagree – control!?

Overall approach…



Date	Time	Temp	Noise Level	Humidity	Light	Window	Fan	Heater	Location
2004-26-11	14:36:01	23	55	30	52	closed	off	off	in
2004-26-11	14:37:01	24	55	30	49	closed	on	off	in
2004-26-11	14:38:01	25	55	30	51	closed	on	off	in
2004-26-11	14:39:01	26	55	30	50	closed	on	off	in
2004-26-11	14:40:01	22	68	30	50	closed	off	off	in
2004-26-11	14:41:01	22	62	30	50	closed	off	off	in
2004-26-11	14:42:01	21	55	30	49	closed	off	on	in
2004-26-11	14:43:01	20	55	30	50	closed	off	on	in
2004-26-11	14:44:01	18	55	30	50	closed	off	on	in
2004-26-11	14:45:01	19	76	30	50	closed	off	on	in

A Fuzzy Decision Tree…



When a Rule for Device Actuation is Triggered

- When a suggestion prompt is issued (which occurs if the user has indicated that a prompt rather than automatic action is required) it is displayed on the main control GUI.
  - if the system suggests that the fan should be turned off, then the UI changes to that shown below - the text on the 'OFF' button flashes black and white.
- In this example the user is shown the confidence level of the rule as a categorical value, in this case 'High'

Scrutinisation…

- If user clicks on why…

- User can also select to see evidence…