Ambient Interface Design (AID) for Aging, Independence and Disability

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Abstract. The global proliferation of increasing longevity in modern society has fixed a focus on assisting the elderly and those living with disability through computing technology. To remain independently empowered, a seamless integration through efficient affable interfaces is required. The Ambient Interface Design (AID) system intends to assist with finding personal preferences and also provide a synchronisation framework to coordinate connectivity across various environmentally distributed devices via sensor data mapping. AID will as a prerequisite for 'Personalised Interfaces', aim to mediate between the needs of the user and the technology to help reduce personal challenges and provide a customised user experience for the efficient selection and acquisition of online information customised to preference, ability and chosen device.

Keywords. Ability-based User Interfaces, Ambient Intelligence, User Sensitive Inclusive Design, Social inclusion, Aging, HCI, Psychology

1 Introduction

Social inclusion and social ethical privacy for all, through technological advancement is an active area of research today with particular emphasis on members living with disability and cognitive dysfunction in a population aging society [6,2,8]. In maintaining autonomy and social independence for these individuals whilst improving self-efficacy, individualism becomes a key element in the design process [7,11,10]. This group's requirements are heterogeneous [5]; therefore enabling the provision of equality in overcoming some disability and without discrimination on ethnicity, background or technical illiteracy makes this a multi-faceted task at a user sensitive design stage.

By providing for minority groups such as those living with disability often in a serendipitous manner leads to better functionality for all. Evidence of this is demonstrated by the text predication systems used in mobile phones. Text predication was originally developed for those with physical disabilities unable to use the standard QWERTY keyboard, and this led to adaptive and predictive interfaces found today on all handheld text messaging telecommunication devices

[7]. These and similar challenges have stretched the design process to explore novel methods in overcoming the question of using personal interface real estate in an optimum way.

2 Interface Design

Too often interfaces were designed with the presumption that they will be the tools of able bodied users with high level cognitive and perceptual capabilities [3]. Interfaces should be adaptable to meet the needs and reflect the context of respective users over multiple mobile and stationary heterogeneous devices, which is the objective of this research. These heterogeneous devices include PDAs, PCs, Smart phones, Flat screens and Laptops facilitating the mobility and flexibility that is the underlying premise of Information and Communication Technology (ICT). The intention is to adapt applications and interfaces to user preferences and in doing increase efficiency and ease of use when moving between devices to complete a task such as an online reservation. This sense of fluidity promotes achievement and reduces stress in permitting the user to fulfil a task with increased flexibility without a requirement to re-authentic as all information is cached and retrieved from the last available page to the new display device. Individual requirements suggests a prerequisite for 'Personalised Interfaces', mediating between the needs of the user and the technology overcoming individual capabilities, preferences and tasks to enhance satisfaction, speed, and performance [4].

2.1 Ambient Intelligence

Ambient Intelligence (Aml) implies building upon the ubiquitous computing paradigm and employing human-centric computer interaction design to develop 'instinctive computing' and fulfil a truly intelligent ambient space. Aml systems would then be capable of providing adaptive and anticipatory user needs through instinctive computing a necessary foundation for 'empathic computing' to understand human state and feelings [1]. Ambient Intelligence has indeed brought a new perspective to the psychology of Human Computer Interaction. The technology is no longer the focus; rather the user becomes central through a physical and digital co-existence [9].

3 Design Principles

The intention of this research is to provide a synchronisation framework that will provide co-ordinated connectivity across various environmentally distributed devices via sensor data mapping and tracking to provide location-independent and application-responsive screening for the personalised user experience. This system may be placed within a user's home or social care establishment. The AID system's main function is the autonomous realisation of a user's presence via Radio

Frequency IDentification-RFID supported readings with the aim of delivering contextual personal user preference interfaces permitting implicit and explicit interaction within a dynamic system. Based on the Supple toolkit [3,4] application, which implements 'decision-theoretic optimization' in automatically generating user interfaces; we will implement a Grails web based Java framework that will utilise a database for authentication, preference elicitation, and interface optimisation and customisation. This information will be used to optimise user preferences at run time over all currently connected device displays. The AID system (figure 1) will take as input the preference elicitation information along with the associated device constraints and customise the interface accordingly.

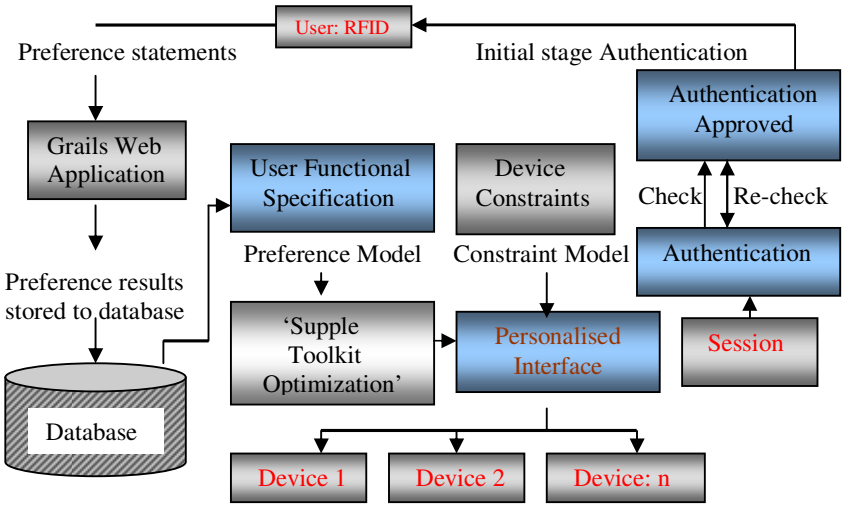

Fig. 1. High-level architecture of AID system components

This communication will permit a many to many (n:n) exchange via shared distributed devices utilised in smart architectural space enabling the creation of surround and fluid protean displays, as illustrated in figure 2.

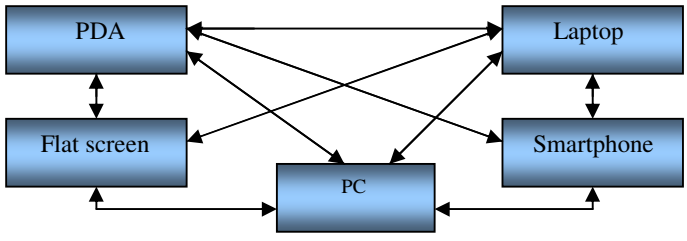

Fig. 2. 1:n Interface integration across heterogeneous devices

A one to many (1:n) configuration is substantiated when a user's tag reading activates a within range device display. A migration theory may also be utilised to provide information regarding user behaviour patterns over time. This will provide additional information that may be needed during device configuration and screen optimisation especially if used in an anticipatory mode of operation.

Amongst the challenges there exists the need to cope with varying levels of uncertainty, such as inaccurate user elicitation credentials, erratic changes in user preference, idiosyncratic user actions and weak sensor signals. The system should be implicit in the nature of its behaviour, exhibit simplicity via its communication interface while appearing logical and natural in its overall mode of operation.

4 Conclusion

Technologically integrated spaces will change our perception of information and our behavioural interactions associated with its provision. The aim is to deliver contextual user preferences without the need for direct user manipulation in overcoming age or disability related issues. In recognising individual capabilities and needs an enhancement of satisfaction, speed and performance should be experienced. Ubiquity and seamless access through Internet services will assist in providing adaptive personal interfaces in mixed mode modality and media. Proactive collaboration between the possible devices aims to capture and simplify tasks for the elderly and those with disability in a sensitive, secure and intuitive environment endorsing efficient support in tailoring to the user requirements.

References

1. Cai, Y.: Instinctive Computing. In: Human Computing, M. Pantic (eds.), LNAI 4451, Springer. (2007)
2. Dong, H., Keates, S., Clarkson, P.J.: Accommodating older users' functional capabilities. In: Brewster, S., Zajicek, M. (eds.): HCI BCS London pp.10-11 (2002)
3. Gajos, K., Z.: Automatically Generating User Interfaces, Ph.D. Dissertation (2008) (access on July 30, 2009)., Online resource, http://www.cs.washington.edu/ai/puirg/papers/kgajos-dissertation.pdf
4. Gajos, K. Z., Weld, D. S., Wobbrock, J. O.: Decision-Theoretic User Interface Generation. In: Proceedings of AAAI'08, NECTAR paper track, Chicago, IL, USA, (2008)
5. Hawthorn, D.: Possible implications of aging for interface designers, Interacting with Computers 12, pp. 507-528 (2000)
6. Jorge, J.: Adaptive Tools for the Elderly New Devices to cope with Age-Induced Cognitive Disabilities., Vol. 2003 WUAUC01 (2001)
7. Newell, A. F.: Commentary on Computers and People with Disabilities: Accessible Computing – Past Trends and Future Suggestions. In: Transactions on

Accessible Computing vol. 1, No 2, pp. 9.1-9.7. ACM (2008)
8. Ng-A-Tham: Equality service accessible for all citizens, in particular elderly and disabled.: TIDE (1998)
9. Remagnino, P., Foresti, G. L.:Ambient Intelligence: A New Multidisciplinary Paradigm. In: Transactions on Systems, Man and Cybernetics – Part A: Systems and Humans, Vol. 35, No 1, January, pp.1-6. IEEE (2005)
10. Stanford Encyclopedia of Philosophy.: Computer Information Ethics (2009) (access on September 10, 2009)., Omline resource, http://plato.stanford.edu/entries/ethics-computer
11. Warschauer, M.: Technology and Social Inclusion, MIT press pp. 5-10 (2004)