Design de interação em serviços inclusivos de governo eletrônico

Este exemplar corresponde à redação final da Dissertação devidamente corrigida e defendida por Heiko Horst Hornung e aprovada pela Banca Examinadora.

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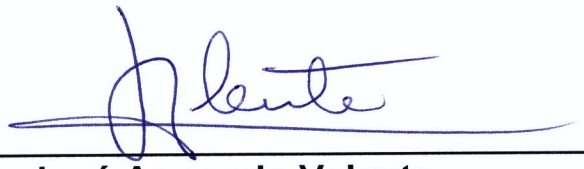

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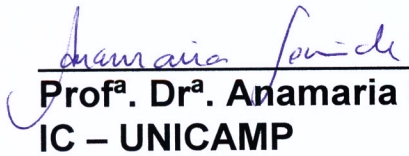

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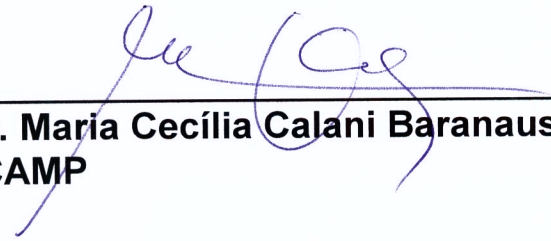

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Design de interação em serviços inclusivos de governo eletrônico

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Setembro de 2008

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Resumo

Serviços do governo eletrônico (eGov, do inglês: electronic government/e-government) são um veículo de comunicação entre as entidades do governo nos diferentes níveis (municipal, estadual, etc.) e os cidadãos. Além de tornar ações do governo mais transparentes e aumentar a eficiência e eficácia, esses serviços visam fortalecer a democracia oferecendo a possibilidade de participação dos cidadãos nos processos democráticos. Para tais fins, serviços de eGov precisam possibilitar o acesso pela população inteira, isto é para pessoas com diferentes competências ou necessidades específicas. A contribuição desse trabalho envolve mostrar caminhos para como interfaces de usuário de serviços de eGov podem ser projetados de uma maneira inclusiva, respeitando a diversidade de uma população.

Partindo de uma análise do contexto brasileiro, esse trabalho mostra tanto as principais diferenças entre serviços de eGov e outras aplicações web quanto as diferenças entre países em desenvolvimento e países desenvolvidos a esse respeito. O principal desafio identificado é a adaptação de métodos tradicionais ao contexto de serviços inclusivos de eGov.

No próximo passo identificamos barreiras do acesso ao serviços de eGov por usuários com necessidades específicas como diferentes deficiências, baixo letramento ou baixo letramento digital. Propomos o conceito de "técnicas assistivas" que ampliam a visão limitada de tecnologias assistivas para o contexto de nosso cenário, isto é, um uso por pessoas que usam serviços em diferentes situações, inclusive deficiências.

Os desafios identificados e diferentes experiências trazidas de projetos nos motivaram a propor um *framework* para o design socialmente responsável. Os elementos principais desse *framework* são métodos e técnicas da Semiótica Organizacional e do Design Participativo para atingir uma visão sócio-tecnica dos problemas de design. Esses métodos e técnicas são aplicados em Práticas Participativas Inclusivas em um Cenário*, um grupo de representantes de usuários finais que foram escolhidos como imagem de características encontradas na sociedade brasileira.

Por fim analisamos um conjunto de protótipos que foram criados dentro do contexto do *framework* de design socialmente responsável. Como o design de serviços inclusivos de eGov depende de fatores culturais entre outros, criamos um *design rationale* abstrato que discute diferentes questões de design e assim visa apoiar o designer na tomada de decisões adequadas ao respectivo contexto.

Abstract

Electronic government (eGov) services are means of communication between entities of the government (on local, state or other levels) and the citizens. Besides making actions of the government more transparent and increasing efficiency and effectiveness, such services aim to strengthen democracy by offering citizens possibilities to participate in democratic processes. Thus, eGov services have to enable access to the whole population, including people with different competencies or special needs. The contribution of this work involves showing ways of creating user interfaces to eGov services inclusively and respecting the diversity of the population.

Starting with an analysis of the Brazilian country context, this work shows the main differences between eGov services and other web applications as well as differences between developing and developed countries regarding those applications. The principal challenge that has been identified is that of adapting traditional methods to the context of inclusive eGov services.

In the next step we identify barriers of access to eGov services that are imposed on users with special needs like impairments, low literacy or low digital literacy. We propose the concept of "assistive techniques" to extend the limited vision of assistive technologies to the context of our scenario, i.e. to people with special needs besides impairments who make use of eGov services in different situations.

The challenges identified and different experiences from different projects motivated us to propose a framework for socially responsible design. The main elements of this framework are methods and techniques from Organizational Semiotics and Participatory Design in order to get a socio-technical vision of design problems. These methods and techniques are employed during Participatory Inclusive Practices in a *Cenário**, a group of end user representatives that has been composed to mirror the characteristics of the Brazilian society.

Finally, we analyze a set of prototypes that have been created within the context of the framework of socially responsible design. Since the design of inclusive eGov services depends on cultural and other factors, we created an abstract design rationale that discusses different design issues and thus supports the designer in taking decisions that are tailored to the respective context.

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During the last two years I not only was a master student but also immersed into a culture that was totally unknown to me. It was – and still is – an excellent experience. I was received very well by the different people at the IC (secretariat, professors, students and other staff) and the few lines in this section are definitely by far not enough to thank all of them.

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Capítulo 1

Introdução

Serviços do governo eletrônico (eGov, do inglês: electronic government/e-government) têm o potencial de trazer muitos benefícios para os cidadãos, empresas, organizações não governamentais (ONG's) e a própria administração pública. Benefícios mais evidentes são mais eficiência e eficácia na execução de serviços. Um benefício para os cidadãos é a facilitação ao acesso de serviços, benefícios para a sociedade incluem maior transparência e uma participação mais direta dos cidadãos nos processos democráticos.

Este trabalho tem foco na interação do cidadão com serviços de eGov; problemas do nível empresarial, de ONG's ou organizações governamentais com serviços de eGov não são tratados. No contexto desse trabalho, serviços de eGov são considerados via a Internet e a interação acontece em um navegador de Internet ou em uma aplicação cliente. Serviços de eGov também podem ser oferecidos via outros canais como a televisão ou celulares, mas considerando a convergência desses mídias achamos que o foco nas aplicações web não impõe uma limitação.

Dentro do conjunto dos problemas dos cidadãos na interação com serviços de eGov, abordamos questões relacionadas à disciplina de Interação Humano-Computador (IHC); problemas de ordem social, psicológica, econômica ou outros são apontados quando têm uma relação com questões de IHC. Esse trabalho surgiu tendo como pano de fundo o Desafio 4: "Acesso Participativo e Universal do Cidadão Brasileiro ao Conhecimento" dos Grandes Desafios de Pesquisa em Computação no Brasil (SBC 2006).

Hoje, muitos serviços oferecidos nos diferentes níveis governamentais (municipal, estadual, federal, etc.) ainda não estão disponíveis eletronicamente. Entretanto, tanto no Brasil, quanto em outros países do mundo, muitas iniciativas foram criadas para disponibilizar tais serviços. Nesse momento é especialmente importante pensar sobre o aspecto do acesso do cidadão, por que, como sempre, antecipar e evitar um erro é no mínimo mais barato do que corrigir esse erro posteriormente, e nesse caso, o custo para corrigir o erro não é só composto por renumerações dos projetistas, engenheiros, etc., mas também pela

inacessibilidade do benefício ao cidadão.

Constatamos que já nos serviços existentes, algumas barreiras de acesso existem. O que pesa ainda mais é que os que mais precisam e mais poderiam se beneficiar desses serviços enfrentam as barreiras maiores: pessoas com deficiências, com baixo letramento e com pouca experiência no uso do computador ou seja, os digitalmente excluídos. De maneira geral essas pessoas também são socialmente excluídas.

Este trabalho não visa ser mais um trabalho sobre diretrizes de acessibilidade ou usabilidade. Já existe um corpo rico na literatura com diretrizes de "propósito geral". Esse corpo será referenciado e examinado com relação à sua adequação ao nosso contexto.

Também não será aprofundada a questão de inclusão social: não vamos discutir se a pesquisa em computação ou avanços na inclusão digital podem contribuir à inclusão social. Essa discussão está sendo feita na comunidade de ICT4D (ingl. "ICT for Development", uso de tecnologias de informação e comunicação para o desenvolvimento; ver por ex. van Dijk (2006)).

O objetivo principal deste trabalho pode ser resumido pela questão de pesquisa "como projetar interfaces de usuário para serviços de eGov de uma maneira que facilite o acesso dos cidadãos Brasileiros?" No percurso desta dissertação vamos primeiro identificar como serviços de eGov diferem de outras aplicações web e como os requisitos dos usuários no Brasil ou outros países em desenvolvimento diferem dos requisitos em países desenvolvidos. Em seguida propomos como facilitar o acesso aos serviços de eGov, estendendo a definição de tecnologias assistivas[1] para diferentes contextos de uso e diferentes necessidades especiais além das deficiências. Situado nesse cenário descrevemos um *framework* para o design de *societal inferfaces* usando métodos do Design Participativo e da Semiótica Organizacional. Uma característica chave desse *framework* são as práticas participativas inclusivas com representantes do público alvo. Com base na análise de uma dessas práticas participativas propusemos um design rationale abstrato para serviços inclusivos de eGov. Um design rationale é um documento que explicita decisões tomadas durante o processo de design e as justificativas para as referidas decisões. No contexto deste trabalho o uso desse artefato foi adaptado para representar e discutir aspectos abstratos e invariantes de *design* e assim apoiar o designer na tomada de decisões informadas.

A parte prática desta pesquisa foi realizada no contexto de dois projetos, um envolvendo o design de interação para serviços de eGov (STID) e outro para o design de redes sociais inclusivas (e-Cidadania). O projeto STID (Soluções de Telecomunicações para Inclusão Digital, (CPqD 2008; Baranauskas, Martins et al., 2007, 2008a, 2008b, 2008c, 2008d)) envolveu a criação de protótipos de dois serviços de eGov: um na área de previdência social e outro na área de saúde. Embora servindo para outros fins de pesquisa, com relação

[1]Dispositivos de hardware ou software para possibilitar que pessoas com necessidades especiais consigam executar tarefas que não conseguiriam executar sem a tecnologia assistiva (exemplo: um leitor de tela).

a esta dissertação, a contribuição maior do projeto STID foi a possibilidade da elaboração de questões de acessibilidade e legibilidade de interfaces onde a acessibilidade é definida de forma mais abrangente, analogamente ao discutido no capítulo 3.

Dentro do contexto do projeto e-Cidadania – um projeto que tem como pano de fundo redes sociais inclusivas – estão sendo definidas aplicações que suportem a constituição de tais redes em comunidades de forma a "fazer sentido" para os cidadãos. Logo, a contribuição desse projeto para o contexto desta dissertação foi, e ainda é, relacionada a questões de inclusão ou o design socialmente responsável (e-Cidadania 2008, Baranauskas et al. 2008e).

Ambos os projetos foram acompanhados por práticas participativas inclusivas em um Cenário* (cenário estrela): um grupo de usuários finais que representam proporcionalmente características e demandas da população de forma geral. O capítulo 4 detalha a constituição do Cenário* como contexto da pesquisa. Durante as atividades com o Cenário* aplicamos diferentes métodos e ferramentas das disciplinas de Design Participativo e Semiótica Organizacional para avançar o estudo da temática a partir da análise de resultados dessas práticas.

O corpo da dissertação é composto de artigos científicos publicados e/ou submetidos a publicação em veículos de seletiva política editorial, na língua dos referidos veículos. O trabalho de pesquisa em questão colaborou e ao mesmo tempo contou com a colaboração de dois projetos de pesquisa envolvendo outros pesquisadores e temas. As principais contribuições deste trabalho são resumidas na próxima seção.

1.1 Contribuições e Organização da Dissertação

As principais contribuições desta dissertação envolvem:

- Identificação de requisitos para o design de interação de sistemas de eGov em países em desenvolvimento.
- Proposta de técnicas assistivas para facilitar o acesso de pessoas com diferentes competências e necessidades aos serviços de eGov.
- Proposta de um cenário para o design socialmente responsável.
- Validação do estudo e proposta de um *design rationale* para serviços inclusivos de eGov.

Os próximos capítulos deste trabalho tratam os seguintes temas:

- Levantamento bibliográfico e identificação de fatores de sucesso para o design da interação em sistemas de eGov com foco em países em desenvolvimento,

- Descrição do contexto Brasileiro e das necessidades dos usuários; identificação de técnicas e tecnologias para usuários de serviços de eGov,
- Proposta de "design socialmente responsável", ou seja, como o design de serviços inclusivos pode ser feito, levando em consideração as necessidades dos usuários descritos no item anterior,
- Situado na abordagem de design socialmente responsável, criação e análise de protótipos e proposição de um *design rationale* para serviços inclusivos de eGov.

Esses quatro itens estão organizados nos próximos quatro capítulos que contem os textos completos dos seguintes artigos publicados ou submetidos para publicação:

Capítulo 2 "*Interaction Design in eGov systems: challenges for a developing country*". Heiko Hornung e M. Cecília C. Baranauskas. SEMISH 2007: Anais do XXVII Congresso da SBC, XXXIV Seminário Integrado de Software e Hardware, SEMISH/CSBC2007, Rio de Janeiro, Brasil, pp. 2217-2231.

> Sistemas do governo eletrônico (eGov) podem ser instrumentos fundamentais para o acesso do cidadão ao conhecimento. O termo eGov surgiu do uso da Internet e constitui uma área de pesquisa e desenvolvimento cujos profissionais enfrentam os desafios da Internet como meio da implementação de novos sistemas e relações entre governo e cidadãos. Participamos hoje no Brasil de um cenário de vastas diferenças socioeconômicas, culturais, regionais e de acesso à tecnologia e ao conhecimento. O grande desafio para mudar esse quadro passa pela busca de métodos e design de sistemas que possibilitem o acesso e sustentem a constituição de uma cultura digital respeitando a diversidade de nossa sociedade. A partir de achados da literatura, este artigo investiga o design da interação em sistemas de eGov apontando lições aprendidas e recomendações para o contexto Brasileiro.

Capítulo 3 "*Assistive Technologies and Techniques for Web Based eGov in Developing Countries – A Brazilian HCI perspective*". Heiko Hornung, M. Cecília C. Baranauskas e Cláudia A. Tambascia. ICEIS 2008: Proceedings of the Tenth International Conference on Enterprise Information Systems, Barcelona, Spain, pp. 248-255.

> Uma meta do governo eletrônico (eGov) é oferecer serviços para a população inteira. Para poder acessar esses serviços e assim se beneficiar de eGov, muitos usuários precisam de tecnologias e técnicas assistivas (ATT, do inglês: *Assistive Technologies and Techniques*). Essa demanda vem de deficiências auditivas, visuais ou outros, mas também do baixo letramento. Este artigo explora os diferentes ATT sob o ponto de vista das condições especiais em países em desenvolvimento. Investigamos quais tipos de usuários podem se beneficiar de ATT de quê maneira e discutimos quais categorias de usuários têm requisitos que ainda não são satisfeitos pelo estado atual de desenvolvimento de ATT. Os demais problemas de acesso podem ser relacionados ao contexto do respectivo país ou às limitações técnicas. Mostramos lições aprendidas que vão nortear trabalhos futuros.

Capítulo 4 "Design Socialmente Responsável: Desafios de Interface de Usuário no Contexto Brasileiro". M. Cecília C. Baranauskas, Heiko Hornung e M. Cecília Martins. SEMISH 2008: Anais do XXVIII Congresso da SBC, XXXV Seminário Integrado de Software e Hardware, SEMISH/CSBC2008, Belém, Brasil, pp. 91-105.

> Denomina-se *societal interfaces* a abordagens avançadas de interação que são explicitamente desenvolvidas para resolver ou tratar problemas sociais específicos e, assim, constituir uma sociedade socialmente e ecologicamente mais sustentável e com melhor qualidade de vida. Neste trabalho apresentamos o conceito de *societal interfaces* e o situamos no contexto da sociedade brasileira onde um dos principais desafios a considerar é o baixo letramento e numeramento que ocorre até nos grandes centros. Discutimos resultados de uma abordagem ao Desafio SBC número 4: Acesso Participativo e Universal do Cidadão Brasileiro ao Conhecimento, sob a perspectiva da disciplina de IHC (Interação Humano-Computador).

Capítulo 5 "*Towards a design rationale for inclusive eGov services*". Heiko Hornung, M. Cecília C. Baranauskas. Submetido.

> A tendência de o uso do computador se espalhar em cada vez mais áreas da vida das pessoas potencialmente pode trazer benefícios para a vida delas. Exemplos são serviços do governo eletrônico nas áreas de saúde ou previdência social. Contudo, algumas pessoas não se beneficiam porque enfrentam diferentes barreiras com relação ao acesso a esses serviços, por exemplo pessoas com deficiências, baixo letramento ou pouca experiência no uso do computador. Este trabalho trata a questão de como facilitar o acesso para tais serviços considerando pessoas com diversas condições físicas e intelectuais. Analizamos idéias de *design* materializadas em quatro protótipos de um serviço de cadastro e exploradas por representantes de usuários finais. Os resultados da nossa análise informam um *design rationale* para apoiar o designer em tomadas de decisões contextualizadas às aplicações e aos cenários de uso.

Outros trabalhos também relacionados direta ou indiretamente ao escopo desta dissertação, embora não façam parte do corpo do texto, foram desenvolvidos e publicados:

Almeida, L.D.A., Neris, V.P.A., Hayashi, E.C.S., Hornung, H.H. and Baranauskas, M.C.C. (2008), An exploratory design for inclusive social networks, Technical Report IC-08-11, IC/UNICAMP.
URL: http://www.ic.unicamp.br/publicacoes

Hornung, H.H., Hayashi, E.C.S., Neris, V.P.A., Almeida, L.D.A., Martins, M.C. and Baranauskas, M.C.C. (2008), Bringing human-computer interaction to an agile process model, Technical Report IC-08-10, IC/UNICAMP.
URL: http://www.ic.unicamp.br/publicacoes

Miranda, L.C., Hornung, H.H., Romani, R., Baranauskas, M.C.C. and Liesenberg, H.K.E. (2008), Estendendo a Idéia do Projeto UCA ao Desenvolvimento Comunitário: Reflexão e Estratégias, em 'XIV Workshop de Informática na Escola, WIE 2008'. SBC, Porto Alegre, RS, Brazil, pp. 107-116.

Miranda, L.C., Hornung, H.H., Romani, R., Baranauskas, M.C.C. and Liesenberg, H.K.E. (2007a), Desenvolvimento Comunitário Nucleado a partir de Laptops Educacionais de Baixo Custo, in 'Anais do XVIII Simpósio Brasileiro de Informática na Educação (SBIE)', SBC, Porto Alegre, RS, Brazil, v. CD-ROM.

Miranda, L.C., Hornung, H.H., Romani, R., Baranauskas, M.C.C. and Liesenberg, H.K.E. (2007b), Laptops educacionais de baixo custo: Propostas de diretrizes visando o desenvolvimento comunitário, Technical Report IC-07-30, IC/UNICAMP.
URL: http://www.ic.unicamp.br/publicacoes

Miranda, L.C., Hornung, H.H., Solarte, D.S.M., Romani, R., Weinfurter, M.R., Neris, V.P.A. and Baranauskas, M.C.C. (2007a), Laptops educacionais de baixo custo: Análise preliminar baseada na escada semiótica, Technical Report IC-07-19, IC/UNICAMP.
URL: http://www.ic.unicamp.br/publicacoes

Miranda, L.C., Hornung, H.H., Solarte, D.S.M., Romani, R., Weinfurter, M.R., Neris, V.P.A. and Baranauskas, M.C.C. (2007b), Laptops Educacionais de Baixo Custo: Prospectos e Desafios, em 'Anais do XVIII Simpósio Brasileiro de Informática na Educação', SBC, Porto Alegre, RS, Brazil, pp. 358–367.

O capítulo de Conclusão sintetiza os principais resultados obtidos ao longo do trabalho e aponta para pesquisa futura.

Capítulo 2

Interaction Design in eGov systems: challenges for a developing country[1]

2.1 Introduction

The way public administration executes its various actions has a direct influence on the well-being of the citizens. Public projects are experiencing a constant change due to evolution in various areas such as organisational learning, technological developments, realignment of government policies etc. The role of public managers must therefore include responsibility for innovation management in public initiatives and projects. However, this responsibility is not limited to public managers. Researchers and the academic sector can and must contribute by systemizing the subject and innovating practices. Furthermore they must contest beliefs that clearly express visions of political authorities, in which good practices or the rearrangement of established structures are sufficient for innovation to happen (Barzelay 2005). Thus, the acceptance of responsibility of each sector of society for the collective well-being, the participation of an active community of public managers and multidisciplinary basis of investigations are fundamental ingredients for innovation. The Brazilian Computer Society (*Sociedade Brasileira de Computação*, SBC) has accepted its responsibility and assumed its active role in constructing the society we want by proposing the Brazilian citizen's participatory and universal access to knowledge (*Acesso Participativo e Universal do Cidadão Brasileiro ao Conhecimento*) as one of the current grand challenges of computer science research in Brazil (*Grandes Desafios de Pesquisa em*

Computação no Brasil 2006-2016; SBC 2006).

To our understanding, electronic government (eGov) systems can be fundamental instruments of citizens' access to knowledge. The terms "electronic government", "electronic governance" or "eGov" appeared in the late 1990s, although the use of information systems in governmental organisations follows the history of computer science since its early beginnings. The term eGov emerged from the use of the internet, and – although not limited to it – constitutes an area of research and development whose practitioners face the challenges of the internet as a means of creative implementation of new systems and relationships between government and citizens.

The federal government of Brazil has proposed eGov projects to combine forces of state- and municipality-level projects. The report "Relatório Consolidado de Planejamento Estratégico do Comitê Executivo do Governo Eletrônico" (RC 2004) points out that eGov has to focus on the demands of the citizens, promoting the access to and the consolidation of citizenship, in particular: the right to the access to public services, the right to information, the right to save time and distance; the right to be listened; the right to a social control of the public agent actions, and finally, the right to political participation. EGov has to be treated as an instrument for profound transformation of the Brazilian society. Moreover, the same report makes clear that this transformation cannot be achieved by simply making more services available in the internet, but by offering services that benefit all citizens, promoting the process of dissemination of information and communication technology (ICT) and contributing to the socio-economic and cultural development of the country.

Nowadays, we are facing a situation in Brazil that is characterized by vast differences with regard to socio-economics, culture, geographical region differences as well as access to technology and knowledge (Baranauskas e Souza, 2006); unnecessary to cite statistics that picture this scenario. The big challenge of Computer Science to change this reality lies in the search for methods and system designs that facilitate access and support the formation of a digital culture that respects the diversity of our society. Starting from results of a literature research regarding human-computer interaction (HCI) issues, this article investigates interaction design in eGov systems using the following questions as a frame of reference:

- What can we learn from eGov experiences of developed and developing countries? Since Brazil is a heterogeneous country with some highly developed regions and many still developing regions, is it sufficient to cherry-pick the most promising strategies of developed and developing countries and try to avoid errors or learn from them, or is it required to adopt a more holistic approach?

- Which results from the international literature are valid for Brazil and which are not? E.g. is there a tendency from national to local eGov?

- How can concepts and methods be localized for Brazil? E.g. can methods of participatory design applied in European projects be re-used or adapted?

The paper is organized as follows: Section 2 presents basic concepts on electronic government and eGov systems; Section 3 synthesizes the main findings from literature on interaction design for eGov systems; Section 4 sets lessons learned regarding interaction design situated in the Brazilian context and concludes.

2.2 Electronic Government

E-government (or eGov, from electronic Government) means the usage of information and communication technology (ICT) for executing business processes in the public sector. There exist various definitions in the literature that – depending on the author – differ slightly or stress certain aspects (Misra 2007; Müller 2004). However, those definitions share a common denominator: all define eGov as the use of ICT in public institutions to improve public services or the government as a whole. To illustrate we present the definitions of the European Commission's Information Society and Media Directorate-General and the Organisation for Economic Co-operation and Development (OECD). The OECD is an international organisation of 30 developed countries that share "a commitment to democratic government and the market economy" (OECD 2007). We chose to present those two definitions because the member states of the European Union and the OECD constitute 19 of the 20 top-rated countries in the United Nations Global E-government Readiness Report 2004 (UN Dep. of Economic and Social Affairs 2004).

The eGovernment unit of the European Commission's Information Society and Media Directorate-General defines eGov as "the use of information and communication technology in public administrations combined with organisational change and new skills in order to improve public services and democratic processes and strengthen support to public policies" (European Commission, Information Society and Media Directorate-General 2007).

The OECD defines eGov generally as "the use of information and communication technologies, and particularly the Internet, as a tool to achieve better government" (OECD 2003).

Many authors see eGov as a promising way of modernizing organisation and administration of governmental institutions yielding more and better services and transparency as well as communication with and active participation of citizens and private enterprises (Müller 2004). From this view, the definitions above and other definitions encountered (Tambouris et al. 2001) the main goals of eGov can be deduced, namely: efficiency, effectiveness, transparency, accountability and e-democracy. It should be noted that e-democracy is not a necessary requirement of successful eGov. One can easily imagine a non-democratic

government that offers certain services electronically, efficiently, effectively, transparently and with full accountability. However, in democratic governments, e-democracy often is seen as the ultimate level of eGov. This is also reflected in the definitions of the European Union and the OECD above. In the following subsections we take a closer look at eGov services, service categories, interaction types and specific eGov challenges.

2.2.1 eGov services

To define the scope of eGov services, we use the eGov application layers defined by Wimmer (2001). On the abstraction level defined by political and strategic dimensions, strategies are developed from visions. On the implementation layer these strategies are implemented in initiatives which then are implemented in projects. Finally on the operational level, projects implement applications (cf. Figure 2.1).

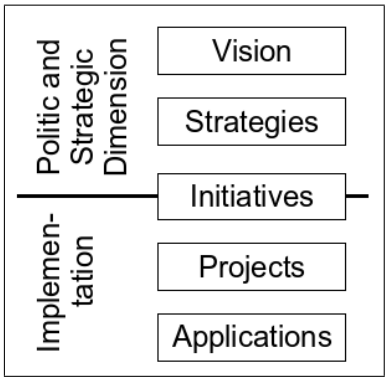

Figure 2.1: eGov application layers. Adapted from Wimmer (2001)

In the context of this paper we take this operational perspective and define eGov services as applications that make use of electronic media in order to accomplish the eGov goals listed above, i.e. we use the terms “service” and “application” as synonyms, although one might argue that a service has a finer granularity than an application and applications are composed of services. The following are some examples of eGov services (Tambouris et al. 2001): certificates applications, tax payment, governmental portals, tele-consulting and tele-consultation, e-procurement, e-forms, online opinion polls, online job vacancies, online statistical data, traffic information, e-forums etc.

This list is far from comprehensive but should give an idea of the variety of possible eGov services. Those services can be categorized in different ways. Some authors identify different categories of eGov according to the content that is actually provided (Tambouris et al. 2001 cited in Garcia et al. 2005):

- Information acquisition: provides access to information about government directives and decisions;
- Service access: allows online transactions of government products and services;
- Participation: enables citizens to participate in the decision making process.

Other authors use different criteria to define different service categories (e.g. Lee et al. (2005), Tambouris et al. (2001) or Gil-Garcia and Martinez-Moyano (2007)). However, regardless of the criteria used, the resulting categories define stages of eGov evolution. We observe that the definitions of the stages we encountered in literature can be mapped to the dimension "degree of interactivity". Usually services in early eGov stages don't provide any form of interaction but the possibility to browse static information. Later stages introduce simple interactions with few interaction cycles like filling out simple forms. More advanced stages offer a broader spectrum of interactivity like online discussions or so called "one-stop government" portals, i.e. governmental portals that deliver services considering users needs (Tambouris et al. 2001).

Although different authors define slightly different stages, all authors agree that a transition of one stage to the next happens by adding technological and organisational sophistication. This progress does not necessarily follow a linear path. Some agencies might skip some stages or offer services from different stages simultaneously in a single initiative. Furthermore, Gil-Garcia and Martinez-Moyano (2007) have found a trend at the aggregate level of eGov initiatives that seems to go from national to state, and to local governments. They state that even in countries with highly developed eGov initiatives on the national level, many local governments are still in very initial stages of eGov. Although they admit that there are exceptions, it must be questioned if these are exceptions or maybe elements of a general pattern. In the context of developing countries we can observe that some highly sophisticated local eGov initiatives are under way while the national or state-wide level of sophistication is relatively low (as a Brazilian example confer the service offering of the municipality of São Paulo (http://www.prefeitura.sp.gov.br)).

At least three different types of interrelations can be distinguished in eGov (Lee et al. 2005; Müller 2004): government-to-government (G2G), government-to-business (G2B) and its reverse, and government-to-citizen (G2C) and its reverse. G2G sometimes is referred to as "internal eGov" and is concerned with processes within or between public institutions, whereas G2B and G2C are referred to as "external eGov". G2C sometimes is also referred to as "government-to-customer". Furthermore some authors describe additional types of electronic interaction. Müller (2004) describes "G2N" as the interaction between government and non-profit or non-governmental organisations. Lee et al. (2005) define "IEE" (government internal efficiency and effectiveness) and "overarching infrastructure". IEE – which is comparable to e-business-like ERP (enterprise resource

planning) applications – can also be seen as a subcategory of G2G, whereas "overarching infrastructure" summarizes initiatives that add technological sophistication to G2G, G2B and G2C services (e.g. public-key infrastructure interoperability, e-authentication across different eGov initiatives). Although Lee et al. (2005) stress the technological character of the category "overarching infrastructure" and compare it to e-business' EAI (enterprise application integration), those services can also have effects on HCI-driven approaches.

2.2.2 Specific eGov challenges

Public service information system development projects have some characteristics that differ from private sector projects and that among others provide a motivation to employ different techniques of user involvement in eGov projects (Følstad et al. 2004):

- The number of stakeholders in public IS is often high, and important stakeholders may be found in several departments of government.
- There may be political attention on and control of the development process.
- Users may include government administration, citizens and non-governmental enterprises.
- EGov services are expected or required to adhere to the principles of Universal Design.
- Since eGov services are typically of a non-commercial nature, customer satisfaction and service production are most important indicators of service effect.
- There might be challenging combinations of requirements, e.g. eGov services have to serve all users and at the same time increase efficiency.
- Public sector projects of a certain monetary volume are often subject to fair vendor competition. Følstead et al. (2004) state that thus, often waterfall-like development processes are employed, since the developing contractor might not be involved in the requirements phase of the project.

There exist various reports that list other organisational and structural challenges and try to address problems implied by the characteristics mentioned (e.g. OECD (2001) and OECD (2003)). Most of the reports state that end-user involvement should be increased. Unlike many e-business projects, target users of eGov services include the whole spectrum of society comprising users with disadvantages (European Commission, Information Society and Media Directorate-General 2006):

- Physiological/mental disadvantage: including short/long term health problems;
- Behavioural disadvantage: criminal behaviour (+ victims), substance abuse;
- Socio-economic disadvantage: low income/poverty, worklessness, homelessness, educational under-achievement including low literacy;
- Demographic disadvantage: gender, age (old, child/youth);
- Ethnic and cultural disadvantage: ethnic/racial minorities, language minorities, cultural minorities, religious minorities;
- Geographic disadvantage: rural areas, peripheral/remote/island, inner-city, etc.;

In the country context of Brazil the diversity of society is even higher. Besides the fact that the claim for participatory involvement emerged from the context of nordic countries who already have a tradition in this area, we believe that also in Brazil, such a broad spectrum of competencies can only be considered appropriately if inclusive and participatory HCI methods and techniques are applied throughout the whole project.

Another aspect that should be explored are the challenges developing countries face. Hugo and Day (2001) as well as Singh and Kotzé (2002) illustrate the challenges that arise in South Africa, a country that is currently being shaped by indigenous socio-economic forces and cultural practices as well as by the forces of globalization. Their findings can probably be projected to other countries in similar situations.

Hugo and Day (2001) state that the cultural, economical and educational diversity in South Africa is especially widespread. Therefore they argue that human factors have a crucial role to play. However, the status of HCI in South Africa can be compared to the status of HCI in more developed countries during the earlier years of this discipline. Another challenge lies in the lack of expertise and resources of the South African government to execute eGov projects. This implies that the government has to rely on academia and industry to execute initiatives promoted by the government, bearing the risk of top-down instead of user-centred designs. On the other hand, the South African government can equally become a powerful sponsor of user-centred design.

Both Hugo and Day (2001) as well as Singh and Kotzé (2002) stress the conflict between globalization and the urge of quickly adapting imported products and technologies to be able to fully participate in global development on the one hand and the danger of thereby excluding various sectors of society from access to and benefiting from ICT. This conflict is due to the importance of cultural values that possibly collide with imported technologies and products.

This special situation in development countries seems to be so extreme that a high rate of failures can be observed (Dada 2006). Heeks (2003) divides eGov projects into three

categories, “total failures”, “partial failures” and “successes”. Projects that result in a “total failure” have not been implemented or the use of implemented applications has been immediately suspended after implementation. “Partial failures” are characterized by the non-achievement of major goals or the occurrence of unwanted side-effects. Projects that resulted in a “success” achieved most of the major goals without unwanted side-effects. Heeks (2003) then estimates that 35% of eGov projects in developing countries are “total failures”, 50% are “partial failures” and 15% are “successes”. To explain the reasons for those failures, he conducts a gap analysis between the current state and the targets to be achieved by an eGov project. Based on this analysis, he identifies three archetypes of eGov failure, hard-soft gaps, private-public gaps and country context gaps. Hard-soft gaps relate to the problem that many eGov projects are designed in a rational, objective and engineering-driven way while government organisations are dominated by “soft factors” like people, politics, emotions and culture. Private-public gaps arise because of differences between the public and the private sector, country context gaps appear when solutions already successfully employed in developed countries are applied to developing countries.

The findings of Heeks (2003), Hugo and Day (2001) and Singh and Kotzé (2002) and the strong need for HCI methods pointed out above could be an interesting starting point for further research.

2.3 Literature research

Our findings from literature research show that the majority of publications on eGov is based on surveys and case studies (Lee et. al 2005). The selection of publications we present in this section does not claim to be exhaustive, but we think it represents an outline of the current state-of-the-art in interaction design and eGov. The collection of papers was compiled searching relevant scientific databases (e.g. The ACM Digital Library (http://portal.acm.org), IEEE Xplore (http://ieeexplore.ieee.org), SpringerLink (http://www.springerlink.com) and Elsevier (http://www.elsevier.com)) as well as the conference proceedings of the Brazilian “Simpósio sobre Fatores Humanos em Sistemas Computacionais” of the last 5 years (i.e. IHC2002 to IHC2006). Furthermore we followed relevant references inside the encountered documents and also conducted searches using regular internet search engines (e.g. http://scholar.google.com). For database and internet searches we used different combinations of the keywords “egov”, “e-gov”, “electronic government”, “government”, “HCI”, “CHI”, “interaction”, “design”, “interface”, “interactive”. We limited the selection to papers that are related to eGov as well as to HCI. Exceptions are some eGov-related papers that have no relation to HCI at first sight, but have at least a relation to computer science in general or a direct or indirect effect on HCI (e.g. OECD recommendations for conducting eGov projects (OECD 2003)). The papers retrieved from

this search can be categorized in:

- design methods – papers in this category treat aspects and problems that arise during different stages of the process of interaction design;
- evaluation methods – papers in this category propose new or show the application of existing user interface evaluation methods;
- HCI practice – papers in this category present case studies that demonstrate the use of HCI methods and techniques in eGov;
- meta level – papers in this category treat problems that arise on higher levels of the aforementioned eGov application layers, e.g. HCI-related success factors of eGov projects and initiatives.

Besides general guidelines and tools related to accessibility and usability (examples are (W3C Web Accessibility Initiative 2006a), WebXACT (formerly known as "Bobby", (WebXACT 2004)), (DaSilva 2006)) we didn't find any that cover HCI aspects specific to eGov services. Regarding national laws and policies, the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C) provides an overview (W3C Web Accessibility Initiative 2006b). One of the best known national laws is the U.S. Rehabilitation Act Section 508 (U.S. General Services Administration 2007), an example for the country context of Brazil is the Lei de acessibilidade - Decreto lei 5296 (Acessobrasil 2004).

In total, 29 documents where reviewed, 9 of which fall into the category "design methods", 8 into "evaluation methods", 5 into "HCI practice", and 7 into "meta level". Almost all papers in the category "HCI practice" and some papers in the category "meta" also deal with design and evaluation methods, but do have no focus on them. Almost all articles in the category "design methods" deal with participatory or at least user-centred design. Table 2.1 summarizes the findings in this category.

Table 2.1: Papers in the category "design methods"

Reference	Commentary
Dawes et al. (2004)	• identification of design dimensions of electronic access programs: – dimensions related to users, uses, suppliers and content (e.g. predictability and homogeneity of users, sensitivity of content, status of metadata) – dimensions related to organizational structure and context of the access program (e.g. relationship with information users and suppliers, suitability of existing technology) • analysis of interdependencies between different dimensions
Dearden et al. (2006)	• pastiche scenarios, e-inclusion, participatory design of eGov services • introduction of "pastiche scenarios", a participatory design method that is based on scenario writing • pastiche scenarios augment "normal" scenarios by using well-known "real characters" from TV, movies, etc.
Filgueiras et al. (2005)	• personas as user models in eGov services – collection of statistical data by means of analyzing questionnaires – data mining and clustering – creation of personas based on clustering
Kavanaugh et al. (2005)	• political online participation of citizens in local governance • two-page paper, no later results could be found yet
Maciel and Garcia (2006)	• e-inclusion; e-democracy • map contents provided by government to a simple language accepted by citizens • language and interaction patterns modelled on TV reality shows like big brother • two-page paper, no later results could be found yet

Continued on next page

Table 2.1 – continued from previous page

Reference	Commentary
Martin et al. (2002)	• ethnographic studies • identification of two examples of the interaction pattern "working with interruptions" in a (non-)computer-supported working scenarios • how to facilitate the (re-)use of patterns in work (re-)design • relation to eGov: business process in which the pattern occurs (planning process) has characteristics that differ from private enterprises
Oostveen and van den Besselaar (2004)	• what methods of participatory design can be used in large scale network eGov systems • focus on multi-national projects with high distribution (network and organization) • no focus on large scale user participation
Vassilakis et al. (2003)	• software engineering perspective • no relation to HCI
Zappen et al. (2006)	• "from user-centred design to user-designer collaboration" • organizational users use software to create content for end-users (children, youths and parents) • organizational users collaborate with designer (software producer), end-users do not collaborate in this example

The papers that fall into the category "evaluation methods" (Table 2.2) are mostly concerned with accessibility and usability evaluations. Singh and Kotzé (2002) furthermore illustrate an example of the application of participatory design methods.

Table 2.2: Papers in the category "evaluation methods"

Reference	Commentary
Becker and Nowak (2003)	• web accessibility assessment; older adults; eGov web sites • presentation of "Dottie", a tool for automated accessibility assessment which resembles "WebXACT"/"Bobby" • paper does not make clear, if Dottie uses guidelines or heuristics that differ from those used by Bobby
Garcia et al. (2005)	• assessment of 127 Brazilian eGov web sites • presentation of "g-quality", an extension of Nielsen's heuristic evaluation (Nielsen 1993) • identification of special eGov usability requirements ("Trust: Demonstrating reliability and credibility, guaranteeing security in the information exchange and in the site navigation.")
Jaeger (2003)	• why many case studies don't measure accessibility accurately • how to measure accessibility more accurately
Jaeger (2004)	• overview of accessibility related laws and regulations in the U.S. • many of the accessibility related laws and regulations that have been identified in this paper have been defined before the widespread use of computers and the internet and don't contain any guidelines, etc. • however, the author shows that many public institutions are legally required to provide accessible web sites even if Section 508 does not apply to them
Pimenta et al. (2002)	• accessibility evaluation of Brazilian eGov sites using tools for automated accessibility assessment and the Web Content Accessibility Guidelines of the W3C-WAI.
Robertson et al. (2005)	• comparative study of using paper based vs. electronically presented information and tools to prepare and execute a voting decision • subject of analysis: navigation on paper vs. computer, ballot metaphor • students as participants

Continued on next page

Table 2.2 – continued from previous page

Reference	Commentary
Singh and Kotzé (2002)	• eGov and HCI in developing countries • cultural identity • example of participatory methods for web usability assessment • ABCD method (atmosphere, build-up, communication, discipline)
Tangarife and Mont'Alvão (2005)	• comparative study of the accessibility recommendations of the W3C/WAI and the Brazilian NGO "Acessibilidade Brasil" using the tool "da Silva"

The papers in the category "HCI practice" (Table 2.3) show how HCI principles are applied to real world eGov projects (Kossak et al. 2001; Marchionini and Levi 2003) or to organizational structures (Hugo and Day 2001; Halstead-Nussloch et al. 2003).

Table 2.3: Papers in the category "HCI practice"

Reference	Commentary
Halstead-Nussloch et al. (2003)	• how to build a HCI community across organizational borders • focus on organizational matters • no focus on users or interaction design • two-page paper
Hugo and Day (2001)	• current state of HCI in South Africa • challenges of developing countries • no direct focus on eGov services
Kossak et al. (2001)	• report of typical HCI related problems in large systems (in this case: Austrian health insurance)
Marchionini (2003)	• invitation to discuss how HCI principles can be applied in eGov projects • two-page paper
Marchionini and Levi (2003)	• description of how HCI principles and practices are applied by the U.S. Bureau of Labour Statistics

The articles in the category "meta level" (Table 2.4) are of a more conceptual nature and describe different organisational aspects of eGov.

Table 2.4: Papers in the category "meta level"

Reference	Commentary
Følstad et al. (2004)	• analysis of eGov projects • which methods of universal design and user involvement are applied • what kinds of users are involved and to which extent are they involved
Gil-Garcia and Martinez-Moyano (2007)	• eGov evolution in stages with increasing technical and organizational sophistication • evolution from national to state to local eGov • public manager's vs. citizens' and other stakeholders' goals • shift of decision-making power from public manager to citizens and other stakeholders and how to influence this shift • paper not directly HCI related
Lee et al. (2005)	• description of eGov stages and categories • assignment of business metaphors (CRM, SCM, ERP, EAI) to eGov categories • examples of eGov initiatives and activities in selected countries
OECD (2001)	• description of challenges eGov projects have to face and recommendations how they can be overcome • no direct relation to HCI
OECD (2003)	• guiding principles and recommendations how eGov can be successfully implemented and its benefits maximized • no direct relation to HCI
Scholl (2006)	• invitation to examine the differences and the similarities of eGov end e-commerce • two-page paper
UN Dep. of Economic and Social Affairs (2004)	• comparative study of eGov readiness and sophistication in different countries worldwide

This literature review has shown, that many papers are concerned with design and evaluation methods. However, as mentioned by Jaeger (2003), those evaluations often use inappropriate measures and often apply a mere "report card mentality" and thus often don't yield meaningful results. Often check-lists and other tools are used that yield results that offer no information about for whom a web site is accessible in what way or why a web site is not accessible. Furthermore, papers on design methods demonstrated the practical use of such methods, but often lacked the direct collaboration of real users. Instead, students or members of the authors' research groups took part in those studies (e.g. (Robertson et al. 2005)), or collaboration was not achieved directly but by means of intermediaries (e.g. (Oostveen and van den Besselaar 2004)). Finally, although there are papers that present different methods and techniques of interaction design, the special aspects that are induced by the eGov context and the special requirements that arise in the context of a developing country are often neglected. Only one paper (Dearden et al. 2006) particularly discusses participatory and inclusive design methods in the context of eGov services, however, not in the context of a developing country. We found papers that pointed out that the simple one-to-one adoption of methods and best practices established in developed countries is one of the reasons why projects fail in developing countries. We didn't encounter literature about how those methods could be adapted to the context of eGov projects in developing countries.

2.4 Lessons Learned for eGov in the context of Brazil – Conclusion

In the previous sections we presented different aspects of eGov in relation to interaction design as well as a synthesis of what literature says regarding our subject matter. Most of the articles focused their investigations on projects and initiatives in highly developed industrial nations; however a few contributions also considered special aspects of developing countries.

Regarding the motivating questions put forward in the introductory section, it has become clear that those cannot be fully elaborated in the scope of this paper. However the preceding sections provided an indication of the direction of future research. In particular, the lessons learned from the literature review point out three fundamental aspects to be considered regarding interaction in eGov systems, especially in the Brazilian context:

1. *Bridging the country context gap:*

   Based on the archetypes of eGov project failures (Heeks 2003) the three gaps (hard-soft, private-public, country context) have to be alleviated with a focus on the

"country context" gap. This means we should not incur in the mistake of adhering to methods designed for other country contexts. Established methods and techniques have to be checked for suitability or adaptability to our context.

Possible reasons for adaptation are that methods have been designed on another cultural background, without taking into account socially/digitally excluded or impaired/non-alphabetized people (e.g. how to do BrainWriting, if people can't read/write, how to test a paper prototype with a visually impaired person)

2. *Involving users:*
   Another key factor is "user involvement"; this has been identified as being crucial by many authors and participatory methods have been recommended; considering the large diversity of the Brazilian society, the methods also have to be inclusive to adhere to the Universal Design principles and to deal with the diversity of disadvantages of our population, especially the massive number of non alphabetized people.

   Can a participatory method always be executed in an inclusive way? Is it sufficient to just "ask" socially/digitally excluded persons to participate? Certainly not; new methods should be proposed for design and evaluation of interaction in eGov for our context.

3. *Providing interactivity in new ways:*

   Considering the two previous aspects, the degree of interactivity is not only dependent on the category of eGov services (information access, service access and participation), but will depend on our ability to design solutions reachable by people with the diversity of competencies we have in our population. In doing that we will be bridging the hard-soft gap, as the rational, objective and engineering driven ways taken in isolation can not cope with this challenge.

In summary, literature analysis in the preceding section evidenced that HCI methods and principles can contribute to improve eGov services in various ways. It has furthermore become clear that eGov is not simply "e-business of the government". EGov projects and applications have many particularities that make it even more important to thoroughly apply HCI methods and principles. We have shown that public institutions differ significantly from private enterprises, and that therefore the goals that have to be realized by implementing eGov services are different as well.

Since e-democracy is one of the most important goals of eGov, the target users of eGov services are not solely economically attractive users that rise sales volumes and profits, but the whole spectrum of the population (except maybe children) within the scope of an eGov service. This means that all possible demographic dimensions (e.g. age, education,

deficiencies, etc.) with all possible characteristics have to be considered. Thus, eGov services can only be successful if HCI plays a role from the very beginning throughout all phases of the whole project.

Capítulo 3

Assistive Technologies and Techniques for Web Based eGov in Developing Countries – A Brazilian HCI perspective[1]

3.1 Introduction

Electronic government (eGov) is intended to serve the whole spectrum of the citizens in a society. Developing countries have characteristics that significantly differ from developed countries affecting directly the design of eGov systems (Hornung and Baranauskas 2007). To illustrate our case we pick Brazil as a representative of this category of nation. Knowing that the situation in developing and emerging countries throughout the world is not uniform we will point out this fact whenever we believe that our considerations are not universally valid. The context of this paper is thence defined by the design of web based eGov services, the country context of Brazil and our HCI perspective towards it. Guiding principles of our research are those of Universal Design, i.e. instead of focussing on solutions for people with specific impairments we search for solutions that facilitate the access for all, in the sense of the largest possible audience.

A web based eGov service is accessible via the Internet. Thus, it is typically accessed via a web browser or other client-side interfaces (e.g. media players with text and graphic

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rendering facilities or any other custom-built application). Although web based services can also be accessed via other clients like mobile handheld devices or digital interactive television, we limit our discussion in this paper to computer based clients. The reasons for this decision are a small (mobile handhelds) or virtually non-existent (digital interactive television) market-penetration on the one hand and too many open questions regarding universal access to these devices on the other hand. Nevertheless, we believe our considerations can also contribute to discussions of those two classes of client devices.

We situate our discussion on web based eGov applications, i.e. services created by a governmental institution to be accessible via the Internet. eGov services can be categorized in three different levels: a first-level service offers static information (e.g. texts of laws, health information, etc.), a second-level service enables the execution of an electronic process (e.g. income tax declaration), whereas a third-level service offers participation in democratic processes (e.g. discussion forums, wiki-style creation of draft laws). The main difference to non-eGov services is that the content of those services tends to be more complex than that of other web applications such as shopping sites or social networking services (by which we do not mean that the design problem to create easily accessible non-eGov sites is trivial).

The goal of this paper is to compile a list of technologies and techniques that can be employed for building and using web based eGov services. Furthermore we propose criteria to evaluate the items on this list and give indications on technologies and techniques best suited to our context.

The paper is organized as follows: Section 2 contextualizes the discussion on the challenges we face in developing countries regarding interaction design for eGov. Section 3 surveys recent literature on related subjects. Section 4 presents our compilation of assistive technologies and techniques focussing on solutions that make sense in our country context. We also present some lessons learned from the technologies and techniques analysis to deal with our major challenge: illiteracy. Section 5 concludes.

3.2 Country context and users – the challenges

The Brazilian population is characterized by a vast diversity regarding different demographic dimensions, disabilities, literacy and digital divide. The aim of this section is not to draw a statistically comprehensive picture of Brazil. Since the scope of our work is the potential inclusion of all citizens, a small, but significant number in any given demographic dimension is sufficient for that dimension to be further considered. About 10% of the Brazilians have a visual impairment, and about 5% have auditory or motor impairments respectively (IBGE 2000).

As there are different methods for measuring literacy there are also different statistics

regarding literacy in Brazil (IPM 2005; UNDP 2007). In the context of the latest Human Development Report of the United Nations Development Programme, literacy is defined as the percentage of people of ages 15 and older "who can, with understanding, both read and write a short, simple statement related to their everyday life." (UNDP 2007, p. 368) and thus an adult illiteracy rate of 11.4% is diagnosed for Brazil. Regardless of the methods and definitions of literacy, the proportion of illiterate and semi-literate Brazilians cannot be ignored.

As to digital literacy, in a 2005 survey of the IBGE, only 22.9% of the Brazilians over 10 years stated that they had accessed the Internet during the last three months. 50.0% of those have accessed the Internet from their own homes. Considering those who exclusively accessed the Internet from their own homes, 38.5% had dial-up access only. The 77.1% who didn't access the Internet during the reference period of three months, 37.2% didn't have access to a computer at all (IBGE 2005).

Considering that a great percentage of the Brazilian population does not have access to computers and the Internet from their homes, telecenters and internet cafés or other public spaces play an important role in providing access to technology and will be considered accordingly in this paper. In Brazil, many telecenter initiatives are government-driven, whereas in other countries non-government organizations play an important role as well. In either case, long-term cost-efficiency and sustainability are important requirements to consider.

We have not yet defined the term "digital literacy", neither do we intend to give a formal definition. In our context, the minimum requirements for the interaction with an eGov service are the proficiency in the use of keyboard, mouse and other peripherals, as well as the ability to use browser-like interfaces that contain text, text input areas, multimedia areas (images, audio or video), links, and buttons or other clickable active areas. Looking at the statistics we presented, we have to presume that a significant part of the Brazilian population does not show sufficient competencies to interact with web based eGov services without further assistance, be it personal or via technology.

Given the context and user scenario described above, we face some challenges that differ from the canon of literature we encountered about assistive technologies. Regarding the users, we are not in a position where we know their competencies and needs, like for example a company that has to fit out a number of workstations to suit the needs of its employees with for example physical or other impairments. Neither is our situation that of an organization or institution that offers a facility where for example people with visual impairments can access computer terminals and count on the help of a trained attendant.

Following the principles of Universal Design, we have to think about solutions that enable people with all possible competencies to use eGov services. Regarding the country context, we can not simply create incentives for people with special needs to buy their own

assistive technology that optimally suits them. In the public or quasi-public areas of access (telecenters, internet cafés, etc.), we can not rely on trained personnel that always can assist users with special needs. Since telecenters are only available in about 50% of the Brazilian municipalities (IBGE 2006), we may often encounter places where private internet cafés provide the only possibility to access computers and the Internet. Considering the lack of public-private partnerships in this area, we can not expect that internet cafés provide all assistive technologies required by potential users in their surroundings. Another challenge that we face are low digital literacy skills of potential users.

3.3 Related work

This paper does not intend to give a comprehensive overview of the field, and some of the technologies presented in this paper are already well known since quite some time. However, we will present exemplary solutions that address some special needs or competencies discussed in further sections and that represent recent developments in the area. The solutions presented show some ideas regarding how to enable the access to eGov services in general as well as how to facilitate access to web based applications for users with low literacy skills and users with auditory, cognitive, motor or visual impairments.

Pilling and Boeltzig (2007) provide a starting point by identifying the lack of assistive technologies as one barrier to the access to eGov services. However, since they follow a strategically focused approach and base their investigations to initiatives in the U.S. and U.K., their findings have only limited applicability to our context.

Independently of different ways of measuring literacy, many people in developing countries have low or no reading skills at all (UNDP 2007). Since eGov services are supposed to reach and benefit especially people with low literacy skills, one essential challenge is to provide access to these users. Medhi et al. (2007) investigate different options to audio-visually represent healthcare-related concepts to people with low or no literacy skills. Their main findings point out that auditory information is very important for comprehension, but can confuse the subjects due to multi-modal effects when used together with visual information; richer information not always results in better understanding. They also examine when to use static images (i.e. photos and drawings) and when to use videos or animations and conclude that it depends on the content to be represented.

The average reading level among the group of deaf people is significantly lower than that of the hearing. Furthermore images and icons that are meaningful to the hearing might not be so to the deaf and hard of hearing. For the community of deaf people, the effort in reading text in a spoken language is comparable to the effort in reading a foreign language. Kennaway et al. (2007) explore the possibilities of providing signed content in web based applications. They identify advantages of signing avatars over videos and propose a set of

tools for the generation and delivery of signed content via a browser plug-in. One of the challenges lies in dynamically generated text with a previously unknown structure; this problem has a similar complexity to the automatic translation between spoken languages and thus signing avatars yield comparable results.

The literature review reveals that accessibility for users with cognitive disabilities is a field where much work still has to be done. Based on the principles of Universal Design, Sevilla et al. (2007) propose guidelines to redesign conventional web content in order to make it cognitively accessible. A comparative study shows that for example short-memory problems do occur in the conventional version of a web page but not in the cognitively accessible version of it.

Assistive technologies for users with motor impairments are often hardware based solutions, e.g. alternative input devices. However, there are also software based solutions that improve the accessibility of standard input devices like trackballs or mice. These solutions are especially interesting in our context since they are potentially easier to deploy and maintain in a large scale basis. Wobbrock and Gajos (2007) compare the target acquisition paradigms "area pointing" and "goal crossing". As opposed to area pointing, users do not click in an area but pass over a target line. Although it seems that users with motor impairments prefer goal crossing and are able to achieve a better performance in certain conditions, many open questions still remain, e.g. how to design goal crossing interfaces or which competencies of users with motor impairments are best suited for this kind of interfaces.

Screen readers and refreshable Braille displays represent the contents of web pages in a linear manner to the blind user. Besides being time consuming, the linearity also may complicate the comprehension of the content, since images, tables and other structural information are perceived differently than by a user with no visual impairment. One approach to overcome this limitation is the use of haptic devices that provide tactile feedback. Kuber et al. (2007) present a participatory approach to design feedback for web based applications. Besides mostly used as a complement for screen readers and other solutions, haptic devices can possibly facilitate the access of users with visual impairments that have no familiarity with the use of screen readers. However, the work on haptic devices has not yet reached a maturity that permits its use in our context.

3.4 Assistive Technologies and techniques

The term "assistive technology" is often defined as a set of technologies "[...] that increase, maintain, or improve the functional capabilities of individuals with disabilities[2] [...]" (U.S.

[2]We intentionally ignore discussions about the appropriate use of terms like "disability" or "impairment" in this paper.

Department of Health and Human Services 2007). Although such technologies are not restricted to computer systems, but also include devices found at the work places or homes of people (e.g. phone foot switches or arm and elbow supports), within the limits of this paper only computer related artefacts are of interest to us. Due to the context previously described, we will include people without impairments but with low literacy skills into our considerations regarding accessibility. Thus we will take a broader view on the subject and use the term "assistive technologies and techniques" (ATT) to describe solutions that have the potential to enable and facilitate the access and use of web based eGov services for our target audience, i.e. citizens with all possible special needs and competencies. This includes assistive technologies, but also methods, best practices or other solutions like earcons (Brewster 1998), the use of multimedia content in web pages, etc. Our work is therefore in-line with the shift from research and development which considers assistive technologies for people with disabilities to Universal Design of solutions for the largest possible audience (Law et al. 2005).

There exists a wide range of special needs implied by conditions such as physical (motor, mobility), sensory (auditory or visual) or cognitive impairments, development disability or mental retardation. Table 3.1 displays a list of categories of assistive technologies examined under the aspect of five significant dimensions:

- *Beneficiary*: denotes the category of user who benefits from the solution: users with auditory, motor or visual impairments (columns A, M, and V) or users with low literacy skills (column L).

- *Input/Output (I/O)*: denotes whether a technology is used during data input (I) or output (O).

- *Implementation in hardware or software (HW/ SW)*: software based solutions work without special hardware (e.g. screen magnifiers); hardware based solutions generally work independently of the application (e.g. braille embossers). The fact that hardware based solutions generally require a driver or other software to function is neglected here, however there are hardware based solutions where the software part is significant (e.g. biometric devices) or where dedicated hardware solutions exist besides the software-only solutions (e.g. speech synthesizers). These cases are denoted by "HW/SW".

- *Maturity*: in our context a technology is considered mature, if it functions with acceptable error rates in our scenario of public access areas with many different users that are potentially unskilled in the use of the technology. The technology has to function under a wide range of environmental conditions since background noise, light, temperature, etc. cannot be controlled. Our measure is a qualitative one and

can not be backed up by quantitative data. A "+" indicates a sufficient, a "−" an insufficient maturity level. A "±" indicates that the technology has an unacceptable maturity level under certain circumstances (e.g. handwriting in the case of optical character recognition and unavailability or low quality of speech synthesizer voices for some languages).

- *Training*: denotes whether an assistive technology can be used without prior training. We do not quantify the amount of training required. A "−" means that no training is required, although the user will improve her performance with increasing familiarity. Technologies with a "+" require a certain amount of prior training. Apart from that, there also exist technologies that have to "learn to interpret" the user input (e.g. voice recognition software). A "(−)" means that the user does not need any training but other knowledge to be able to use the respective technology (e.g. users of refreshable Braille displays need to know Braille).

Disregarding entries that only indirectly benefit certain categories of user (entries marked as "(x)"), a look at the table shows that there seems to be quite some solutions for people with visual impairments, not quite as many for people with auditory, cognitive and motor impairments and very few solutions for people with low literacy skills.

Regarding the deaf and the hard of hearing, the solutions presented in the table either require literacy skills (TTY/TDD conversion modems), are only suited for very specific purposes (light signaler alerts) or are not yet mature enough to be used in a large scale off-laboratory scenario (gesture recognition, sign synthesis).

Apart from technologies for data input (keyboard filters and hardware based input devices), there seem to be no technologies specifically developed for users with cognitive impairments.

Solutions for people with low literacy skills are under-represented. This is not astonishing since many assistive technologies emerged from the "computer at work" context in developed countries that show high literacy rates. Furthermore the challenge for users with low literacy skills is not the sensory access of computers or contents. Thus, solutions for this user category will be mainly based on assistive techniques described below.

Assistive technologies for people with motor impairment are focused on hardware based solutions for data input.

Although it seems that assistive technologies for people with visual impairments are well represented in the table, solutions for people with the most severe impairments, i.e. blindness and very low vision, require a certain amount of training (screen readers, speech recognition) or further knowledge and skills (Braille).

Another aspect that is not explicitly shown in Table 3.1, but nevertheless important refers to cost. Regardless whether public access points are run by government agencies

or non-government organizations, cost will play an important role for the deployment of assistive technologies in developing countries. There will be trade-offs between the academically desired optimal solution (making available the technologies that are best suited for the users that use a given point of public access) and the practically feasible solution. An example are alternative input devices for people with motor impairments, some of which accommodate very special needs. Regarding the issue of cost, solutions will be preferred that suit more than one special need. Software based solutions are preferable to hardware based ones: maintenance is cheaper and often free implementations already exist, although they not always offer all functionality of commercial solutions.

Table 3.1: Assistive technologies

Assistive technology	Beneficiary					I/0	HW/SW	Maturity	Training
	A	C	L	M	V				
Screen enlargers, screen magnifiers					x	O	SW	+	−
Braille embossers					x	O	HW	+	(−)
Screen readers					x	O	SW	+	+
Speech and voice recognition		x	x	x	x	I	SW	−	+
Text-to-speech (TTS) or speech synthesizers		x	x		x	O	HW/SW	±	−
Refreshable Braille displays					x	O	HW	+	(−)
Keyboard filters		x	(x)	x	x	I	SW	+	−
On-screen keyboards				x		I	SW	+	−
Light signaler alerts	x					O	HW	+	−
TTY/TDD conversion modems	x				x	I/O	HW	+	(−)
Alternative keyboards	(x)	x	(x)	x	x	I	HW	+	(−)
Touch screens	(x)	(x)	(x)	(x)	(x)	I	HW	+	−
Other alternative input devices (e.g. electronic pointing devices, wands, sticks)				x		I	HW	+	(−)

Continued on next page

Table 3.1 – continued from previous page

Assistive technology	Beneficiary					I/O	HW/SW	Maturity	Training
	A	C	L	M	V				
Peripherals (e.g. micro, web cam)	(x)	(x)	(x)	(x)	x	I/O	HW	+	−
Scanners	(x)	(x)	(x)	(x)	(x)	I	HW	+	−
Optical character recognition (OCR)	(x)	(x)	(x)	(x)	(x)	I	SW	±	−
Biometric identification devices	(x)	(x)	(x)	(x)	(x)	I	HW/SW	−	−
Motion capture, gesture recognition	x					I	HW/SW	−	+
Text-to-sign or sign synthesis	x				x	O	SW	−	(−)

To summarize the analysis of Table 3.1, although there exist many different categories of assistive technologies that attend many special needs, the number of potential solutions diminishes when we consider our specific context. Since according to our literature research many authors have dedicated themselves to assistive technologies for auditory, motor and visual impairments and since solutions for cognitive accessibility require a research profile that differs from ours we restrict our further considerations to people with low literacy skills. Further comparative analysis of technologies or concrete products are out of the scope of this paper.

3.4.1 Lessons Learned for People with Low Literacy Skills

This subsection discusses assistive techniques for users with no or low literacy skills. In the context of this paper, assistive techniques are methods for facilitating access to web based content. In contrast to most assistive technologies, content becomes inherently more accessible when applying assistive techniques. Although limiting ourselves to the problem of literacy, we borrow from the body of methods intended to benefit users with other special needs. On the other hand, our considerations can possibly contribute to the areas we borrow ideas from as well.

The challenge for people with low literacy skills is twofold, since they are often novice computer users. Since many usability guidelines deal with the performance of novice users, we will exclusively focus on the literacy aspect.

According to Table 3.1, the set of assistive technologies adequate for people with low literacy skills comprises speech and voice recognition systems, text-to-speech synthesizers, keyboard filters, alternative keyboards, touch screens, scanners and other peripherals, optical character recognition software and biometric identification devices.

Voice recognition can be used for authentication purposes, speech recognition for text entry or navigation. Although these solutions seem the most interesting for this user-category, there are some indications that suggest they are not appropriate solutions for our context. Apart from technical problems like background noise or the recognition of natural, free-style speech (Deng 2004), speech recognition systems usually initially need to be trained and adjusted to the individual user's characteristics. Moreover, speech recognition in public places collides with the user's privacy requirements.

Alternative keyboards with spatially clearly structured areas and differently colored keys (e.g. letters, numbers and "function keys" like enter, space, backspace, etc.) benefit users with low literacy as well as users with some cognitive or visual impairments and are a feasible solution in our context of public access points, since the coloring can be done even for keyboards already purchased and in use. Touch screens diminish the attention split between screen, keyboard and mouse, and thus not only benefit users with cognitive impairments but also users with low literacy skills.

Scanners and OCR software could be used to replace manual data entry that can be found on documents like utility or telephone bills. An aspect that cannot be neglected, however, is that these documents could contain other data that the user might not want to divulge.

A similar argument applies to biometric identification devices. Although the identification or authentication processes can be simplified, the registration of biometric characteristics like finger prints or iris scans in a government system can create other psychological barriers of access.

Although we could identify assistive technologies that bring benefits to users with low literacy skills as a side effect, much more potential lies in assistive techniques discussed in the remainder of this section. We identified the following categories of assistive techniques:

- *Accessibility, usability and other design guidelines and principles*: to our knowledge there exist no guidelines, recommendations or principles explicitly tailored to the requirements of people with low literacy skills and published by consortia like the W3C or other organizations. Apart from sources directly related to the subject matter (e.g. Huenerfauth (2002) or Medhi et al. (2007)), our findings reveal that many guidelines, recommendations or principles for users with other special needs also bring benefits to users with low literacy skills. Although intended for the deaf and hard of hearing, some of the findings of Fajardo et al. (2006) are directly related to literacy and thus applicable to our case. The simplification of web page structure

and content that benefits users with cognitive impairments (Sevilla et al. 2007), also benefits users with low literacy skills, since a simplification will yield web pages with less textual information and texts presented in a language and grammar that is easier to understand.

- *Standards or recommendations*: generally, all standards or recommendations that deal with alternatives to text-based or visual interfaces, text layout, and the augmentation of textual information by multi-media content are relevant. This list comprises but is not limited to the W3C activities, recommendations or candidate recommendations (W3C 2007) CSS (Cascading Style Sheets, a mechanism for separating text content from layout), the Multimodal Interaction Activity (provides the possibility to dynamically select the most appropriate mode of interaction), SMIL (Synchronized Multimedia, an XML-based language for interactive multimedia presentations), SVG (Scalable Vector Graphics, an XML-based language for describing 2D graphics and graphical applications), or the W3C Speech Interface Framework (including markup specifications like VoiceXML for telephone-based interaction with web applications). Although having great potential, new challenges arise to make applications accessible that use these techniques (Gibson 2007).

- *Individual solutions*: The literature that elaborates individual solutions ranges from case studies that try to identify techniques by analyzing design processes or results to proposals that study novel approaches. Akan et al. (2006) develop an electronic screening tool for rural primary care, Plauché and Prabaker (2006) a telephone based system for market and ambient information that can be used uttering a set of pre-defined command words. A solution for novice computer users that also facilitates access for users with low literacy skills is presented by Chand and Dey (2006). Although these three and other solutions for users with low literacy skills are fundamentally different from each other (in the three examples above simple minimalist touch screen interface vs. completely auditory interface with speech recognition vs. creation of printed macros that are activated by a barcode scanner), they all follow similar principles: present a minimal and simplified interface, minimize or eliminate the necessity of reading or entering textual data, and using alternate media (audio, images, video) either redundantly or exclusively.

Our literature study showed that a body of best practices seems to be evolving. Auditory feedback is considered crucial. Apart from giving explicit linguistic feedback, we could draw inspiration from solutions that are intended for users with visual impairments (e.g. Eiriksdottir et al. 2006), techniques that use abstract non-speech sounds to facilitate menu navigation or similar tasks (e.g. Brewster 1998; Dicke et al. 2007).

The principle to create simple and minimalist interfaces that avoid unnecessary complexity is also found in the literature about Universal Design and cognitive impairments.

Another best practice that seems to be consensus is the use of visual information like drawings, photos, animations or videos. Although certainly very important, the use of related techniques has to be carefully planned since there exist no universally valid rules regarding which kind of visual representation is optimal. Furthermore cognitive effects have to be considered when using textual, auditory and visual representations simultaneously. Leahy et al. (2003) discovered that depending on the task complexity and the redundancy of auditory, textual and visual information, it is sometimes better to use fewer types of different media.

3.5 Conclusion

This paper presented an overview of ATT in the context of challenges we face in developing countries when considering interaction design for eGov. Our overview has shown that although there are a variety of assistive technologies, there remain many gaps, especially considering the scenario of public access points in developing countries. We have shown that particularly for users with low literacy skills, assistive techniques may offer many possible solutions to be investigated. Although there is no clear body of rules regarding the optimal employment of the techniques, since many of them depend on various factors, they encourage further research. Some of these solutions are now being investigated in the context of interaction design for an eGov project in Brazil.

Capítulo 4

Design Socialmente Responsável: Desafios de Interface de Usuário no Contexto Brasileiro[1]

4.1 Introdução

À medida que o computador pessoal perde sua posição dominante escapando aos ambientes de escritório, passa a levar a Tecnologia da Informação e Comunicação (TIC) a novos grupos de usuários em ambientes domésticos, em espaços públicos e outras configurações não tradicionais. Essa difusão da vida cotidiana com TIC promove um interesse renovado em como essas tecnologias podem ser utilizadas para lidar com problemas sociais complexos e urgentes que a humanidade enfrenta. Denomina-se *societal interfaces* a abordagens avançadas de interação que são explicitamente desenvolvidas para resolver ou tratar problemas sociais específicos utilizando a disciplina de Interação Humano-Computador (IHC) e, assim, constituir uma sociedade socialmente e ecologicamente mais sustentável e com melhor qualidade de vida (Tscheligi 2007).

Sob a expressão *societal interfaces* são tratados sistemas relacionados ao bem estar e qualidade de vida, saúde, segurança e outras formas de proteção, empregabilidade, sustentabilidade (do ambiente), educação, inclusão digital e acesso à informação para todos, citando alguns. No contexto da sociedade brasileira esse tema ganha novas proporções, dadas as estatísticas apontando para porcentagens da população que não têm acesso ao

mundo da leitura e escrita (Baranauskas e Souza 2006), sem contar suas barreiras ao uso da tecnologia da informação e comunicação, na forma em que ela se apresenta hoje. Neste trabalho situaremos o conceito de *societal interfaces* no contexto da sociedade brasileira em seu Desafio SBC número 4: Acesso Participativo e Universal do Cidadão Brasileiro ao Conhecimento (SBC 2006). Apresentamos e discutimos a abordagem que temos utilizado no enfrentamento desse desafio na busca de soluções de design de interface e interação àqueles em que o analfabetismo funcional soma-se naturalmente ao analfabetismo digital.

Soluções para o Desafio 4 envolvem uma larga cadeia de tópicos da Ciência da Computação, com implicações desde o nível de infra-estrutura e hardware para acesso, até o desafio de soluções de interface para uma população com a diversidade da nossa. Em termos de pesquisa, este artigo aborda questões relacionadas à chamada terceira onda em IHC (Bodker 2006), onde o contexto de uso da tecnologia e tipos de aplicação são estendidos e inter-relacionados relativamente ao foco da segunda onda, que é o trabalho. A terceira onda em IHC aponta para desafios relacionados à fronteira cada vez mais nebulosa entre o trabalho formal e outros aspectos da vida cotidiana; entre o conceito de utilidade e usabilidade do software por um lado e as qualidades hedônicas do sistema por outro; ingredientes que qualquer proposta de enfrentamento do Desafio 4 deve considerar. Além disso, soluções que envolvam multiplicidade e multi-mediação de artefatos físicos e/ou lógicos, e a possibilidade de interfaces de usuário (IU) flexíveis ao seu ajuste para e por grupos de usuários parecem também promissores ao tratamento da 3ª. onda.

O objetivo deste artigo é apresentar uma abordagem de pesquisa ao Desafio 4, que temos conduzido sob a perspectiva da disciplina de IHC (Interação Humano-Computador) e discutir resultados preliminares do estudo. O artigo está organizado da seguinte forma: a Seção 2 apresenta um panorama de tendências da pesquisa em IHC que são alinhadas ao conceito de *societal interfaces* visando contextualizar a pesquisa; a Seção 3 descreve a abordagem que temos considerado para tratar o problema; a Seção 4 apresenta e discute resultados preliminares e as primeiras lições aprendidas e a Seção 5 conclui.

4.2 A Terceira onda em IHC e o conceito de *Societal Interfaces*

Novos artefatos têm aparecido desde que o *desktop* tornou-se parte do cotidiano de trabalho das pessoas e tais artefatos têm mudado a natureza da interação humano-computador de maneiras que ainda não se entende bem. Há o fator mobilidade modificando locais e contextos de uso da tecnologia e novas modalidades de interação têm surgido. O contexto de trabalho não é mais formado de documentos individuais, mas pressupõe uso compartilhado de documentos e serviços em rede. Ao mesmo tempo, o uso da tecnologia, que extrapola

os limites dos locais de trabalho, torna menos definida a fronteira entre o trabalho e outras partes da vida das pessoas (Bodker 2006). Nesta seção discutimos a evolução pela qual a disciplina de IHC tem passado, e situamos o conceito de *societal interfaces* nessa evolução.

Em um trabalho seminal, Bannon (1991) chama a atenção para o fato de que os termos usados em determinada disciplina oferecem pistas de como os seus membros "enxergam" aquela área. Nesse trabalho o autor identificou a passagem da 1ª. para a 2ª. onda em IHC, ao propor no vocabulário da disciplina a substituição de "fatores humanos" para "atores humanos". Essa proposta sinaliza para uma mudança de percepção para o papel da pessoa na interação humano-computador conotando, no primeiro caso um indivíduo passivo, fragmentado, despersonalizado, desmotivado e no segundo caso um indivíduo ativo e no controle da situação. Trata-se de uma referência a abordagens da área de Fatores Humanos que, embora tenham mérito em introduzir melhorias em sistemas tecnológicos, reduziam o ser humano a mais um componente, com certas características (atenção espalhada, limite de capacidade de memória, etc.), a ser "equacionado" no sistema homem-máquina. Usando a expressão "atores humanos", a ênfase é deslocada para a natureza holística da pessoa agindo em um dado ambiente (no caso o contexto de trabalho), em contraste com a visão da pessoa como um conjunto de mecanismos de processamento de informação à semelhança do que ocorre no processamento de informação na máquina.

A 2ª. onda mudou o foco do indivíduo para grupos trabalhando com uma coleção de aplicações. Novas teorias passaram a tratar contextos de trabalho e interação dentro de comunidades de prática bem estabelecidas. Ação situada, cognição distribuída e teoria da atividade foram reconhecidas como fontes importantes de reflexão conceitual. *Guidelines* rígidas, métodos formais e testes sistemáticos, característicos do período da 1ª. onda foram, a maioria deles, substituídos ou complementados por métodos pró-ativos e abordagens qualitativas para estudar o uso de tecnologia enquanto ele acontece: oficinas de design participativo, prototipação, design contextual são alguns exemplos (Bodker 2006).

O que vivemos hoje, em relação a características da 2ª. onda, é o uso de múltiplos contextos e tipos de aplicações de forma ampliada e inter-relacionada. O foco da 3ª. onda, como aponta Bodker (2006), parece estar definido em termos do que a 2ª. onda não é: não é voltado ao trabalho, não têm propósito bem definido, não é racional, etc. Conceitualmente, a terceira onda de IHC tem foco em aspectos culturais representados por fatores estéticos (Bertelsen 2006), expansão de fatores cognitivos aos emocionais (Norman 2002, 2004) e fatores pragmático-sociais da experiência (McCarthy e Wright 2004). Na terceira onda a tecnologia extrapola os limites do contexto de trabalho para estar nas casas das pessoas, em suas vidas e cultura. Novas tecnologias têm aparecido ajudando também a compor a cena da 3ª. onda: tecnologias ubíquas, móveis, pequenas, em geral apresentadas como configurações ad-hoc de soluções técnicas isoladas. Esse é o cenário que já está presente, ainda que indiretamente, mesmo em um país de grandes diferenças sócio-econômicas como

o nosso.

Metodologicamente ainda não temos indicações claras de novos movimentos necessários à terceira onda. O estágio atual parece contrapor por um lado o contexto de trabalho e racionalidade das ondas anteriores e por outro, lazer, artes e vida doméstica. Transcender essa dicotomia sem negar completamente os pressupostos da 2ª. onda, mas ao mesmo tempo dando conta de novos parâmetros que se impõem nessa visão holística da interação preconizada pela 3ª. onda é a essência do que precisamos no design de *societal interfaces*.

4.3 Uma abordagem ao Design Socialmente Responsável

No design *socialmente responsável*, em vez de pensar o design de aplicações e contextos de uso de novos artefatos como substituições aos antigos, entendemos que diferentes usos e experiências são possibilitadas via uma combinação de tecnologias especializadas. Para tal consideramos a existência conjunta desses artefatos (físicos e lógicos) ao abordar tópicos como **multiplicidade** (de artefatos, de usuários, de interação), **fronteiras** (do conhecimento e uso de tecnologia), **experiência** (de vida) e **participação** das partes interessadas no processo e produto de design. Investigamos soluções de design envolvendo diferentes artefatos e seu uso combinado entre contextos e competências diferentes de seus usuários. Novos referenciais teórico-metodológicos devem também ser investigados, confrontados com os relativos à chamada segunda onda, para dar conta de novos aspectos do design incluindo os emocionais, os da experiência e reflexão.

O desenvolvimento da pesquisa e abordagem proposta neste trabalho pressupõe a participação conjunta da equipe de pesquisadores com uma comunidade parceira, na investigação de soluções de design multi-artefato para suporte a relações sociais inclusivas, construção e compartilhamento de conhecimentos. As soluções propostas estão sendo "desenhadas" com as partes interessadas utilizando referencial teórico-metodológico adaptado da Semiótica Organizacional (Liu 2000; Stamper 1996; Bonacin et al. 2004) em práticas participativas. A Figura 4.1 ilustra nossa proposta conceitual para lidar com o Desafio 4, via *Societal interfaces*, considerando também o movimento da 3ª. onda de IHC. Nessa figura situamos nosso entendimento do design de sistemas e tecnologia em uma "cebola semiótica"[2] onde o nível Técnico (design de tecnologia) pressupõe o conhecimento dos níveis Informal e Formal do domínio. Nesse sentido signos das camadas informal e formal do grupo social são necessários para se contemplar de fato as necessidades de determinado recorte da sociedade (Cenário*[3]) com relação aos artefatos técnicos. Práticas Participativas

[2] "Semiotic onion" (Liu, 2000) no conceito original da Semiótica Organizacional

[3] Cenário estrela; * como metáfora para fecho transitivo da Teoria dos Conjuntos

Inclusivas (PPI) são propostas metodológicas que objetivam clarificar os signos dos níveis informal, formal e técnico do conhecimento atravessando as três camadas desse *framework* semiótico.

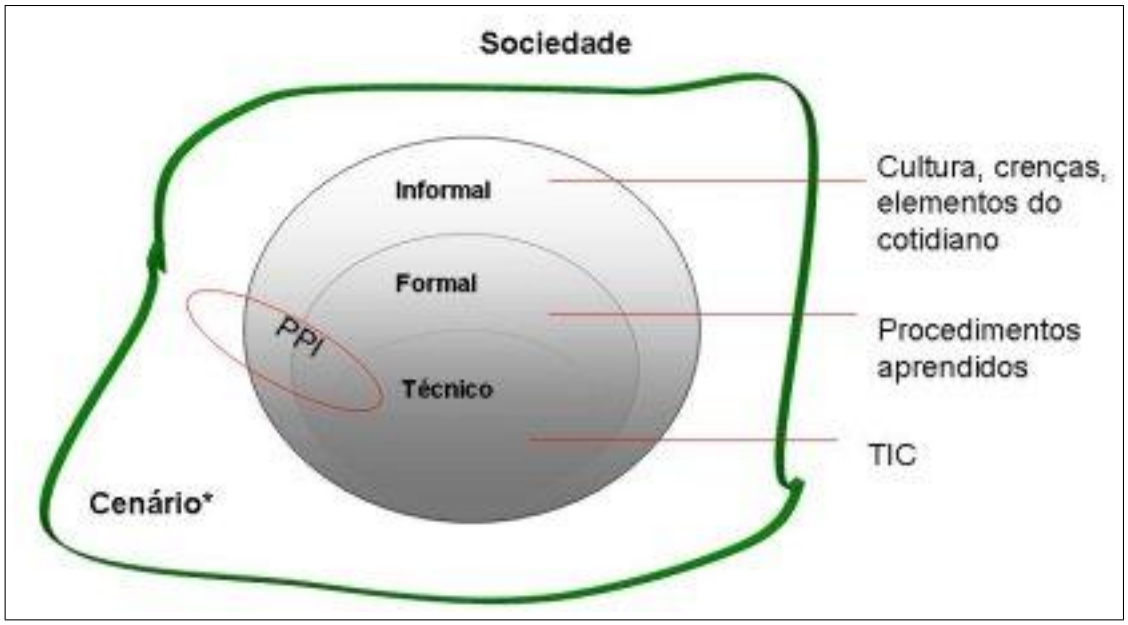

Figura 4.1: *Framework* conceitual para a abordagem proposta.

Assumimos como base os princípios do *design* universal (Story 1998). O primeiro desses princípios trata o uso eqüitativo, i.e. um design deve ser utilizável por pessoas com habilidades diversas. No contexto do design participativo, isso significa que se deve considerar essa multiplicidade de competências ao escolher representantes de usuários para serem incluídos no processo de design.

"Uso eqüitativo" também significa que ninguém deve ser discriminado. Uma discriminação acontece também quando se atribui um peso grande demais a uma dada habilidade, privilegiando uma dada competência em detrimento de outras. Como no contexto deste trabalho os usuários são os cidadãos brasileiros, a constituição de um grupo de seus representantes deve considerar a multiplicidade de habilidades presente em nossa população. Com essa finalidade, definimos o Cenário*.

4.3.1 O Cenário*

Um Cenário* visa representar as várias habilidades do usuário de um sistema. Para sistemas computacionais cuja audiência são os cidadãos, os dados mais relevantes são os dados demográficos. No nosso caso específico, a base da constituição de nosso Cenário* são dados do censo demográfico de 2000 do Instituto Brasileiro de Geografia e Estatística (IBGE

2000) e o Indicador de Alfabetismo Funcional (INAF) do Instituto Paulo Montenegro (IPM 2005). A mesma metodologia pode ser usada para constituir um Cenário* para sistemas de outra natureza, com outra audiência, supondo disponíveis os dados estatísticos relevantes.

Uma restrição importante na escolha de características relevantes para a constituição de um Cenário* é o tamanho do grupo para as práticas participativas. Nas práticas dentro do contexto deste trabalho, de 10 a 15 pessoas foi considerado um tamanho adequado para a natureza do design participativo, número esse que deve ser somado ao número de pesquisadores. Definido o tamanho do grupo, nos propusemos a contemplar as seguintes características demográficas: deficiências[4], analfabetismo, renda média por domicílio, faixa etária, e gênero. Na característica "deficiência" distinguimos entre "sem deficiência", "deficiência auditiva", "deficiência motora" (deficiência física, em membros, motora) e "deficiência visual". Na característica "analfabetismo" distinguimos entre "analfabetos" (agrega analfabetos e analfabetos funcionais), "alfabetizados básicos" e "alfabetizados plenos". Quanto à renda média por domicílio, distinguimos entre classe A (agrega classes A1 e A2), classe B (agrega classes B1 e B2), classe C, classe D, e classe E. Na característica "faixa etária" distinguimos entre "15 a 30 anos", "30 a 45 anos", "45 a 60 anos", "60 a 75 anos" e "75 a 90 anos". Quanto ao gênero, distinguimos mulheres e homens.

Por razões de ordem prática fizemos algumas simplificações ou agregações na constituição do Cenário*. Uma agregação foi feita na característica "deficiência física" dado o tamanho limitado do grupo de representantes (10 a 15) e da baixa porcentagem dessas pessoas na população brasileira (um total de 6 por cento significa um representante em um grupo de 15). Agregamos analfabetos e analfabetos funcionais buscando constituir o grupo da forma mais natural e menos discriminatória possível. Por essa razão optamos por não realizar testes de leitura com os participantes; em vez disso utilizamos dados de um questionário com – entre outros aspectos – questões sobre a escolaridade dos participantes. Com relação à "renda média do domicílio" utilizamos os mesmo critérios usados para contemplar a característica "deficiência". A representação de faixas etárias enfim foi definida em função do tamanho do grupo (10 a 15 pessoas): uma granularidade mais fina significaria que teríamos faixas etárias com uma pessoa no grupo, um fator que dificultaria a constituição do grupo sem trazer muitos benefícios para os resultados da pesquisa.

Dada a disponibilidade das respectivas estatísticas, esse modelo permite a constituição de grupos representativos do nível macro (Brasil inteiro, regiões ou unidades federais) até o nível micro (município, bairro, etc.). Limitações originam de inexatidões devido à necessidade de arredondar valores para grupos relativamente pequenos e de restrições na

[4]Nesse ponto intencionalmente não queremos entrar na discussão sobre o uso adequado dos termos "deficiência", "habilidade" ou "necessidade especial"; simplesmente citamos os termos usados no Censo 2001 do IBGE.

constituição do grupo; a satisfação exata de proporcionalidade de todas as quantidades de todas as características em consideração exigiria um processo de seleção mais formal com muito mais candidatos do que os escolhidos. Entretanto, isso contradiria a nossa tentativa de constituir um grupo representativo da forma o mais natural possível, um requisito para a colaboração mútua natural e respeitosa entre todos.

Considerando esse raciocínio, o modelo descrito foi levantado com a intenção de nortear a constituição do grupo dos representantes dos usuários finais. Assim, adotamos a heurística de priorizar as características demográficas na seguinte ordem: "analfabetismo", "deficiências", "faixa etária", "renda média do domicílio" e "gênero" e tentar cumprir todos os critérios da melhor maneira possível dentro do que preconizam os princípios do Design Universal e do pragmatismo necessário à participação de todos nas atividades de design. Como recrutamos os integrantes do grupo a partir de um bairro de classes C e D, classes estas que totalizam dois terços da população brasileira, foi relativamente simples chegar a um grupo cuja composição é muito próxima do modelo calculado.

Vale salientar que o Cenário* representa uma "fotografia" da multiplicidade de nossa população, sem a pretensão de esgotá-la ou ser completa. Contudo, é possível incluir no grupo pessoas com características, competências e/ou habilidades específicas para a condução de determinadas atividades de design e avaliação. Por exemplo, é o caso de atividades pontuais envolvendo especialistas como analistas de acessibilidade e usabilidade, intérprete de LIBRAS (Língua Brasileira de Sinais), para atividades que incluam pessoas surdas ou cegas.

4.4 Práticas Participativas Inclusivas em um Cenário*

Conforme discutido anteriormente, considerando a realidade brasileira, na qual 74% da população são analfabetos funcionais e o desenvolvimento de aplicações inclusivas e de acesso universal, um grupo de usuários – Cenário* – foi constituído e algumas práticas participativas (PPI) foram desenvolvidas com estes participantes em Telecentro de uma Vila. Esta seção ilustra algumas práticas iniciais que objetivaram identificar preliminarmente a maneira como fazem sentido de aplicações web na forma em que existem hoje e também a maneira como se expressam em atividades de design – vocabulário que utilizam, metáforas e outros signos que empregam – para interpretação de seus pares.

O Cenário* em questão é formado por pessoas do sexo feminino (8) e masculino (4), com faixa etária de 20 a 73 anos, tem um nível de escolaridade e de familiaridade tecnológica diversificado (ensino fundamental incompleto (5), completo (2), ensino médio regular (2), supletivo do 2º grau (1), graduação em andamento (2). Estes dois últimos usuários, os mais jovens do grupo, atribuem um grande valor ao fato de estarem cursando uma faculdade, pois esta situação não é comum no círculo de convivência de ambos. Quanto à atuação dos

homens no mercado de trabalho há aposentados (2), trabalhador informal (1), monitor em iniciativa de inclusão digital (1). Dentre as mulheres, algumas nomeiam sua atuação como "do lar" (3) e as outras são: diaristas (1), dama de companhia de pessoa idosa (1), artesã (1), estagiária no serviço público (1) e sem vínculo definido de trabalho (1). Uma das mulheres apresenta surdez total.

Dada a metodologia adotada para a composição do grupo (heurística descrita na seção anterior e o princípio de constituir um grupo representativo da forma o mais natural possível) e dada a amostra relativamente pequena de potenciais participantes, a composição do grupo baseou-se no preenchimento dos critérios consideradas algumas prioridades. Quanto mais alta a prioridade da característica demográfica considerada menor a diferença entre o valor teórico calculado no modelo e o número de pessoas no grupo específico atendendo o referido critério. No caso específico do grupo constituído, a característica letramento/numeramento teve maior prioridade do que a de gênero, por exemplo.

Em relação ao uso da tecnologia, a mais utilizada e que faz parte do dia-a-dia dos usuários é a televisão e para alguns o rádio também. O computador, embora seja conhecido (7 tem computador em casa com Internet de linha discada), não é utilizado pela maioria. Quase todos possuem celulares porém executam apenas procedimentos básicos (atender ligação, desligar dispositivo). O uso de caixa eletrônico em serviços bancários também não ocorre de forma confortável. A maioria dos que possuem cartão de banco, revelam sentimento de desconfiança e insegurança e prefere interagir com o funcionário do estabelecimento bancário.

A dinâmica de trabalho da PPI que usaremos para ilustrar parte da proposta envolveu um momento inicial para chegada e ambientação dos participantes e apresentação das atividades do dia, seguido de momento de realização e discussão da primeira atividade, intervalo, realização e discussão da segunda atividade. Cada atividade durou aproximadamente uma hora e as respectivas discussões, meia hora. A primeira atividade propôs a realização de uma tarefa em grupo no computador e a segunda atividade, no formato de um jogo, propôs a cada grupo a composição de um painel com imagens e texto que expressasse uma dada frase relacionada ao mesmo domínio utilizado na primeira atividade.

Atividade exploratória no computador

A tarefa dos grupos era verificar se um dado medicamento se encontra na Relação Nacional de Medicamentos (RENAME), disponibilizada pelo governo federal no site do Ministério da Saúde (http://www.saude.gov.br). Após a apresentação da tarefa, os facilitadores encaminharam os grupos para o laboratório (telecentro da Vila), onde 6 computadores estavam com os *browsers* abertos na página inicial do Ministério da Saúde. Os facilitadores entregaram aos participantes a folha da Tarefa 1 e certificaram-se de que o grupo havia

entendido a tarefa. Os facilitadores também orientaram o grupo a escrever na folha a resposta obtida como resultado da busca. Ainda no início da atividade, cada facilitador solicitou que o grupo expressasse verbalmente seus pensamentos e suas ações durante a navegação. Essa técnica, denominada *Thinking Aloud*, possibilita o registro das estratégias adotadas para a tomada de decisão, na realização da tarefa.

Resultados
Os grupos levaram em média 28 minutos para concluir a atividade, sendo que apenas metade deles chegou à resposta correta (Figura 4.2).

Estação	Tempo	Concluiu com êxito?
E1	25 min	não
E2	20 min	não
E3	18 min	sim
E4	45 min	sim
E5	15 min	sim
E6	45 min	não

Figura 4.2: Tempo e resultado dos grupos quanto à realização da tarefa

Esta atividade no Cenário* permitiu identificar as principais dificuldades e habilidades dos usuários no ambiente da internet. Alguns usuários digitalmente instruídos, diante da dificuldade para encontrar a informação solicitada, decidiram utilizar a ferramenta de busca. Os usuários com maior grau de escolaridade perceberam a necessidade de ler mais, após não terem encontrado a informação através da busca por imagens e palavras chave. No geral, a principal dificuldade foi a confusão entre o RENAME e uma lista com preços de medicamentos comercializados pela Farmácia Popular. Nesta atividade pôde-se observar que o foco de atenção dos usuários era colocado nas figuras dispostas no *site*. Para a maioria dos usuários a quantidade de texto do site desencorajou e atrapalhou a navegação.

Atividade de expressão – um Jogo
O objetivo da atividade era que cada grupo montasse um painel com imagens, desenhos e/ou textos representando uma sentença relacionada ao domínio anterior previamente

sorteada para o grupo. Após a finalização do painel, cada grupo mostrava o seu painel aos demais grupos, para que os mesmos tentassem associá-lo, como em jogos de revistas, com uma das sentenças apresentadas. A proposição deste jogo considerou aspectos do método Paulo Freire de alfabetização (Freire 1991). Neste método, Paulo Freire coloca a importância de se buscar palavras e temas mais significativos da vida das pessoas que estão sendo alfabetizadas, dentro de seu universo vocabular e do contexto da sociedade em que ele está inserido. Mapeando o princípio desse método para o desenvolvimento de uma aplicação Web, objetivamos durante a realização do jogo e do diálogo estabelecido entre os usuários, identificar signos do domínio (vocabulário e metáforas significativas) utilizados por eles.

Como material, um painel (Figura 4.3) foi confeccionado para funcionar de maneira similar ao quadro branco, onde é possível escrever e apagar com facilidade. Permitir o ato de apagar nesta atividade é fundamental por conceder aos participantes uma maior segurança e liberdade durante a fase de criação do painel e de troca de idéias entre os membros do grupo. Um conjunto de figuras foi elaborado de maneira a incluir imagens diversas, tendo ou não relação direta com o assunto abordado na frase sorteada. Os verbos foram escritos por extenso no mesmo formato das figuras. Cada grupo recebeu o mesmo material para compor o seu produto final: um painel branco, um conjunto de figuras, conjunto de palavras chave, caneta, apagador, tesoura e fita adesiva.

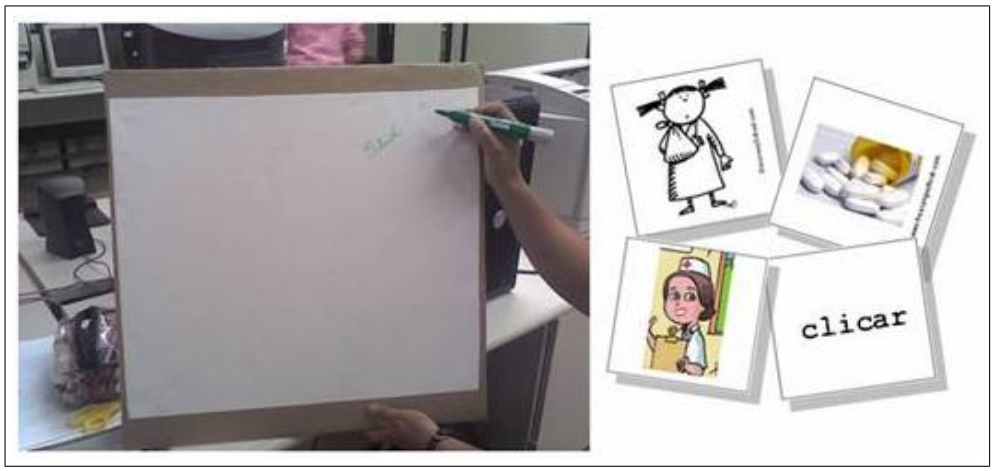

Figura 4.3: Painel e figuras

Todos tinham a liberdade de introduzir novas palavras e/ou figuras, escrevendo e/ou desenhando diretamente no painel. No início da atividade, quatro frases foram lidas pelo facilitador e em seguida as frases foram sorteadas e entregues aos grupos. As frases eram curtas e motivadas por atividade anterior no site do Ministério da Saúde, por exemplo: "*Na Internet eu posso buscar informações e dicas de saúde*" e atividades do cotidiano

dessas pessoas quando utilizam um Posto de Saúde.

O objetivo de cada grupo era representar o melhor possível a frase de maneira a facilitar a interpretação dos demais. Os demais grupos deveriam identificar qual era a frase original e ganhariam pontos tanto o grupo de autores do painel (3 pontos), como o grupo que conseguisse interpretar corretamente a mensagem (1 ponto). Ao final, o grupo vencedor seria aquele que totalizasse maior número de pontos.

Resultados

Em geral, o tipo de uso que os participantes fizeram das figuras foi bastante parecido entre todos os grupos. Foram usadas em média 6 figuras dentre as quase 30 figuras disponíveis. A maioria dos grupos usou figuras para fazer referência a substantivos da frase. Houve mobilização dos grupos em escolher imagens e palavras essenciais ao entendimento do conteúdo representado no painel, e também a busca de símbolos familiares ao perfil da turma. O Grupo 2, por exemplo, buscou utilizar figuras/textos que fossem mais representativas para as 3 palavras: Saúde, Informação, Internet. Notou-se a preferência ou necessidade de expressar ações por palavras escritas (em vez de figuras), assim como pronomes, como ilustrado na Figura 4.4a.

Observamos que três dos quatro grupos representaram a frase de maneira linear, em uma seqüência gramatical idêntica a de um texto escrito, da esquerda para direita, obedecendo o formato da escrita como ilustrado, por exemplo, na Figura 4.4a para "*Seu atendimento do dia 28 de setembro às 15:00h no posto de Saúde mais próximo da sua residência foi cancelado*". A interpretação dos demais grupos (decodificação) para os painéis também parece ter buscado esse mapeamento linear. Evidência disso é o fato de quando mais de uma figura disposta de forma linear e seqüencial foi utilizada para representar uma mesma idéia ter gerado confusão para os grupos que tentavam descobrir a frase representada.

Apenas um dos grupos aproveitou melhor o espaço bidimensional do painel para compor uma mensagem mais figurativa, de forma assemelhada à distribuição de elementos na tela em um ambiente web: Figura 4.4b para "*Na Internet eu posso buscar informações e dicas de saúde*".

Esse mesmo grupo apresentou as informações-chave (internet, informação, saúde) organizadas em blocos dispostos em regiões distintas da tela. Esta disposição já é uma forma visual de tratar a informação diferenciada da estrutura linear da escrita. O grupo utilizou uma figura central e significativa para elaborar a informação ao redor dela.

Outro fato relevante diz respeito à escolha de imagens significativas: para representar a "internet" nenhuma das figuras disponíveis para esse fim (que remetiam a "mundo" e "rede") foi escolhida. A composição de elementos – "computador e pessoa" – foi preferida pelos grupos para representar a internet. Este dado ressalta a necessidade de se buscar elementos culturalmente significativos e ajustáveis à categoria de usuário em questão. Por

(a)

(b)

Figura 4.4: Representações linear e não-linear respectivamente

outro lado, alguns símbolos gráficos remeteram diretamente aos seus referentes, como o caso do "X" para "cancelado".

É interessante observar também a preferência dos participantes por determinadas figuras do conjunto das 30 figuras disponíveis. A Figura 4.5a apareceu em todos os quatro painéis para representar atendimento (de Saúde), mesmo existindo outras figuras que tivessem o mesmo fim e a mesma possibilidade de representação, como mostra a Figura 4.5b.

Também, a imagem da enfermeira que aparece na Figura 4.5b foi utilizada em dois dos 4 painéis, sendo que em um deles para representar a idéia de "agendamento". Tal representação reflete o conhecimento de mundo desses sujeitos que, ao freqüentarem o "postinho" (expressão que utilizam para "Posto de Saúde"), são atendidos pela enfermagem,

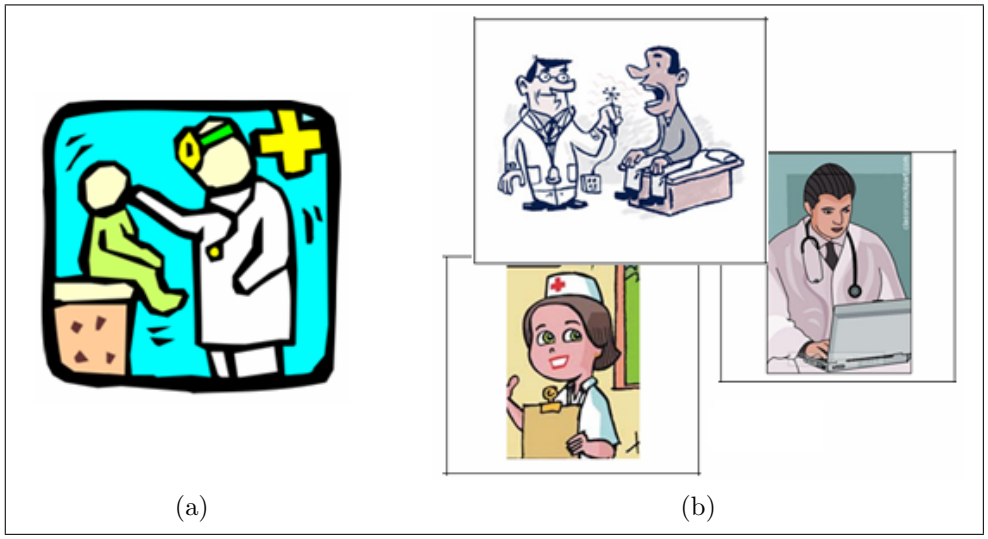

Figura 4.5: Representamens para atendimento no contexto de saúde

que é quem de fato os atende e encaminha ao médico. Essa associação foi claramente compreendida pelos demais grupos.

Em síntese, a prática participativa do jogo possibilitou identificar elementos de vocabulário pertencentes ao cotidiano e experiência de vida dos participantes do Cenário* e a maneira como eles compõem/recompõem idéias de forma pictórica. As escolhas que eles fazem dos elementos de representação nem sempre coincidem com escolhas que o designer faria, como mostrou por exemplo o caso da representação para "internet". Esse fato reforça os pressupostos de nossa abordagem quanto à necessidade de imersão em Cenários* para se fazer design de sistemas inclusivos.

4.4.1 Discussão e Lições Aprendidas

A diversidade na composição do Cenário* se refletiu na análise dos resultados das atividades.

Com relação ao "letramento digital", alguns usuários mostraram grande dificuldade no uso do *mouse*, tanto no "apontar" quanto no "clicar": eles não tinham controle sobre o movimento do cursor na tela, clicavam com o botão direito e não conseguiam sair do menu de contexto, ou movimentavam o mouse quando clicando, resultando em um evento de marcação de texto em vez de um clique simples. Outros problemas freqüentes ocorreram com *pop-ups* nas páginas HTML e com barras de rolagem. Outros usuários, que já haviam tido contato com computadores e a internet, mostraram dificuldades quando as páginas entravam em conflito com o vocabulário de interação previamente aprendido, por exemplo texto em azul ou imagens sem *hyperlink*.

Outros fenômenos observados são relacionados ao baixo letramento que é um catalisador

para problemas de usabilidade *web*. Os participantes usavam imagens nas páginas para se orientar, mas encontraram dificuldades quando a interpretação deles para a imagem era diferente da pressuposta intenção dos criadores da página. Eles não percebiam ou só perceberam muito tarde ambigüidades como por exemplo termos semelhantes para conceitos diferentes (e.g. "aqui tem farmácia popular" e "farmácia popular do Brasil"). Quando foi acionada uma busca local no site (e.g. endereço de um posto de saúde em um dado bairro), um usuário anotou informações que estavam espacialmente próximas dos termos de busca sem perceber que não era a informação correta. Ainda, para os membros do Cenário*, uma estrutura hierárquica baseada em conteúdo, como em geral ocorre nessa categoria de *site*, é muito pouco acessível.

Quanto ao conteúdo textual, ficou claro que para levantar um vocabulário adequado é necessário fazê-lo participativamente, por que a evasiva "tem especialistas do domínio na equipe" do *design* de sistemas da primeira e segunda ondas de IHC certamente não conta mais: os cidadãos são os especialistas. Por outro lado, isso não significa que o sistema deva ficar livre de termos técnicos do domínio.

A mesma regra vale para mapear processos existentes para um sistema computacional: levando em consideração requisitos funcionais, para que um processo "faça sentido", os detalhes dele devem ser elucidados participativamente. Aqui enfrentamos mais um fator complicador, ainda em aberto. Constatamos a influência que a experiência real de vida dessas pessoas tem em seu processo de fazer sentido das tarefas via sistema computacional. Por um lado essas experiências podem ser diferentes dos procedimentos reais existentes (e.g. causado por um atendimento errado); por outro lado, um processo eletrônico muito provavelmente vai diferir do procedimento no mundo e muitas vezes isso é desejável na medida em que introduz novas funcionalidades ou abandona velhos hábitos ineficientes.

Todos esses fatores dependem de uma abordagem ao problema que primeiramente dê conta de capturar esses fenômenos para em seguida propor soluções de design inclusivas. Como mencionamos na seção 2, novos elementos devem entrar em foco ao se trabalhar com *societal interfaces* que não são contemplados nos métodos da segunda onda de IHC. Os resultados preliminares de nossa vivência no Cenário* têm mostrado que outros parâmetros são necessários e se sobrepõem aos conceitos tradicionais de usabilidade e acessibilidade; a relação afetivo-emocional e de engajamento das pessoas com a tecnologia e com os seus pares via tecnologia tem sido mais dominante do que eficiência no uso; e o acesso ao conhecimento tem se mostrado muito mais produto de redes sociais, onde o respeito às diferenças de cada um é muito maior do que o imaginado pelos que propõem usos da tecnologia.

A imersão no Cenário* tem sido uma experiência desafiadora também e principalmente para os pesquisadores e temos consciência da complexidade envolvida na análise de resultados das PPI. Podemos estar apenas arranhando o topo do iceberg, mas acreditamos

na necessidade dessa imersão para conhecer as dimensões do problema e suas potenciais soluções.

4.5 Conclusão e Novos Desafios

Fazer *design* de tecnologia tem implicações na relação que pessoas estabelecem com essa tecnologia, como a utilizam e como se beneficiam dela. Ainda, novas características têm surgido no cenário das tecnologias de informação e comunicação (e.g. ubiqüidade, tamanho, natureza do uso) que trazem outros parâmetros a considerar nessa relação (e.g. a relação afetiva tão presente nas redes sociais mediadas por TIC). Vivemos em um momento do desenvolvimento tecnológico, onde não é mais suficiente pensar essa relação apenas pelo seu aspecto ergonômico ou utilitário.

Num contexto de multiplicidade cultural e de competências no uso da TIC como é o caso do nosso, o tratamento desse contexto é fator determinante para como queremos ver o uso dessa tecnologia em benefício de nossa sociedade como um todo nos próximos anos. Neste artigo apresentamos o *framework* que propomos para lidar com a questão do Desafio 4 o Acesso Participativo e Universal do Cidadão Brasileiro ao Conhecimento. Discutimos o que entendemos por *design socialmente responsável*, situando-o na tendência que se apresenta para a pesquisa em IHC e ilustrando com resultados preliminares do estudo.

Para realizar o acesso participativo e universal, o *framework* proposto nesse artigo pode oferecer soluções para problemas de IHC em duas frentes: por um lado as Práticas Participativas Inclusivas ajudam no design de interfaces acessíveis – dado que entendemos acessibilidade não só no sentido clássico, mas também no sentido de legibilidade, compreensibilidade. Por outro lado a abordagem proposta é essencial para a definição de aplicações que fazem sentido para o usuário. Consideradas isoladamente, ambas são condições necessárias mas não suficientes: sem uma interface acessível/legível não se realiza o acesso participativo e universal ao conhecimento; sem uma aplicação que faça sentido para o usuário e assim o motive ao uso da tecnologia também não.

Artigos como o de Bodker (2006) ou a definição do Desafio 4 mostram que os pesquisadores reconhecem tanto a mudança do foco de uso da tecnologia do ambiente profissional para o ambiente particular quanto a forte necessidade de tomar medidas para que a situação dos já desfavorecidos não se deteriore ainda mais. Contudo, só nos encontramos no início desse caminho: não existem resultados prontos e a transferência do conhecimento para a indústria depende de resultados da pesquisa. Este trabalho marca um dos primeiros passos. O *framework* proposto permite uma visão abrangente dos problemas, a abordagem "de baixo para cima" favorece a sustentabilidade de projetos de cidadania mediada pelo uso de tecnologia e o uso do Cenário* visa possibilitar uma aplicabilidade para outros

contextos e uma generalidade para escalas maiores.

A terceira onda em IHC traz novos desafios dos quais alguns são particularmente importantes na perspectiva de *societal interfaces*: um deles envolve o tratamento do contexto. Embora considerações de contexto tenham sido centrais na pesquisa durante a 2ª. onda, a 3ª. traz novas dimensões ao considerar o contexto geral da cultura do ser humano, em particular nossa vivência em situações do cotidiano mediadas pelo uso de tecnologia. Para lidar com questões sócio-técnicas no design de sistemas que considerem essa visão ampliada de contexto, novos referenciais teórico-metodológicos são necessários. Resultados preliminares deste trabalho e outros que estamos conduzindo sugerem o potencial de abordagens semióticas como base. A multi-mediação de linguagens do cotidiano e de artefatos tecnológicos pode encontrar apoio nessa disciplina. Do ponto de vista prático, o design de aplicações de TV digital interativa certamente se beneficiará de pesquisa nessa direção, especialmente no cenário de Brasil.

Outro desafio a considerar envolve o confronto com métodos das gerações/ondas de IHC anteriores. Métodos tradicionais de avaliação de interface de usuário não se adequam à realidade que encontramos ao longo das PPIs no Cenário*. Exemplo disso é o tratamento da emoção e aspectos afetivos no design e na avaliação da interação com tecnologia. Desafiar o padrão já estabelecido à avaliação de usabilidade de interface de usuário é uma necessidade que já se evidenciou; novas propostas devem ser construídas a partir de outras bases, sem negar a discussão sobre racionalidade e propósito, típicos da 2ª. onda.

Por fim, mas sem esgotar o assunto, pesquisa em interfaces ajustáveis (ou *tailorability*) oferece grande potencial para se criar soluções aos desafios da 3ª. onda em IHC, especialmente no contexto de *societal interfaces*, se considerados dois aspectos principais: a participação do usuário e a multiplicidade de artefatos. O primeiro refere-se à participação direta do usuário no processo de ajuste da aplicação e no processo de design para o ajuste (aqui novos entendimentos são necessários aos conceitos de participação e de *end-user programming*). O segundo refere-se ao ajuste de configurações para a convivência de múltiplos artefatos interativos.

Capítulo 5

Towards a design rationale for inclusive eGov services[1]

5.1 Introduction

Information technology is becoming ubiquitous and is being diffused into more and more areas of life. Consequently, its audience is more diverse than ever, demanding special considerations regarding the user interface and interaction design issues. Bødker (2006) used the term "the third wave of HCI (Human-Computer Interaction)" to discuss some of the related phenomena: whereas second wave HCI focused on work settings and users interacting in well-established communities of practice, the focus of third-wave HCI shifts to computer use in private and public spaces, from workplaces to everyday life. A problem that arises with this third wave is that it does not reach all people, a problem that is also known as the digital divide. To cope with the digital divide, many initiatives are underway, often driven by government agencies (e.g. (European Commission 2006)).

In developing countries, the gap between those who have access to information and those who have not is the widest. Two of the reasons are the high illiteracy rates and the limited access to information technology in these countries. In 2006, the Brazilian Computer Society (Sociedade Brasileira de Computação, SBC) addressed the problem of the digital divide defining one of five Grand Challenges for the Brazilian Computer Science Research as: "Participatory and Universal Access to Knowledge for the Brazilian Citizens" ((SBC 2006)). One important facet of this challenge is related to HCI specific topics. On this background, this paper contributes by elaborating on the question of how to design user interfaces that are accessible to our target audience, i.e. users with all kinds of competencies and needs, with low or no literacy skills and with low or no computer

[1] **Chapter submitted for publication**

skills. Even within the community of HCI practitioners, this question is still challenging.

Whereas one can find a substantial amount of literature about accessibility regarding visually or physically impaired users, literature addressing the difficulties of users with low literacy skills is hardly existent. Hornung, Baranauskas & Tambascia (2008) present some examples of relevant literature and point out the fact that existing solutions usually require a considerable amount of prior knowledge from the user, for example training in the use of a screen reader.

In this paper, we present and discuss results of observing people in the Brazilian scenario interacting with four disposable computer-based prototypes, designed for exploring user interface ideas considering access to technology by the less favored. We have also considered lessons already learned from other previous research on societal interfaces ((Baranauskas, Hornung & Martins 2008, Hornung, Baranauskas & Tambascia 2008)). As a result, we constructed a design rationale to inform further eGov interaction design.

The paper is organized as follows: the next section presents an overview of the Scenario we are working with and the four user interface prototypes; the third section conducts an analysis based on related literature and the observations made during the interaction of end user representatives with the prototypes; the fourth section describes the design rationale that resulted from the prototype analysis; the last section concludes.

5.2 The Research Scenario

Brazil is a country with a diverse population. Approximately 14% of the Brazilian people have some kind of impairment (auditory, visual, physical, etc. (IBGE 2000)), 38% of the population have only basic literacy skills (i.e. are only capable of extracting information from short texts), 37% have no or rudimentary literacy skills (i.e. do not read at all or are only able to extract explicit information from very short texts, e.g. newspaper headlines (IPM 2005)). Vast amounts of the population have no access to computers in their homes, many neither in public spaces (IBGE 2005). The high illiteracy rate and the high rate of people with no or low access to computers make the situation of Brazil significantly different from that of developed countries. Nevertheless, aligned with principles of Universal Design or Universal Accessibility (Stephanidis, Akoumianakis, Sfyrakis & Paramythis 1998), our findings should also be useful for the context of developed countries as well.

As a motivation, consider the following scenario: nowadays, a user of the Brazilian public health system has to go to one of the public health centers to schedule an appointment with a physician. Normally he or she has to wait in line for a couple of hours (if not to return the next day because the numbers already run out) and gets his or her appointment marked for some days or weeks thereafter. In regions with a low population density, the trip to the health center alone requires considerable time and effort. The benefits of

electronically scheduling an appointment on a public access terminal are obvious.

On this scenario and background, this work investigates how to enable and facilitate access to web based services, whereas potential users of those services include users with impairments as well as low or no literacy or computer skills. The focus on web-based services is a pragmatic choice: web or browser based services are the dominating type of services in Brazil and neither cell phone nor TV based services, nor kiosk based or other standalone applications show a significant market penetration.

The approach we take is to propose a design rationale based on the analysis of four prototypes of a simple registration service and the observations made during the interaction of end user representatives with those prototypes. The motivation for this approach comes from the fact that due to different service types, usage scenarios and users' needs, different answers may be valid to the questions we pose depending on the context situation. Thus, a design rationale might provide a better support to the designer in taking informed decisions.

5.2.1 Presentation of four prototypes

The four prototypes presented in this paper were developed by four groups of 3 to 4 post-graduate students of a "Human Factors in Computer Science" discipline at the University of Campinas during the second semester of 2007, to experiment design ideas for the diversity we find in our population. Before the activity of prototype creation, the students were appointed three tasks on the topics "Citizens' access to knowledge via technology: developing and developed countries", "Auditory memory: implications on the interaction model", and "Users with low literacy skills, visual or hearing impairments: solutions to access Information and Communication Technology". Each of the three tasks included a review of the relevant literature (refereed journal and conference papers in the past five years), the selection of one to three articles, and a presentation and discussion of the synthesized findings.

The design task was formulated as: "Consider the development of a web application for a telecenter in Brazil. The target users include illiterates, functional illiterates, digitally excluded, people of old age, and people with visual and hearing impairments. Propose a solution for the registration of the target users in the system". The creation of the prototypes was accompanied by in-class activities exercising methods of Participatory Design such as BrainWriting and BrainDrawing (Muller, Haslwanter & Dayton 1997).

5.2.2 Prototype 1 – minimalist web form

This prototype (cf. Figure 5.1) has a minimalist layout, similar to general web forms found in various sites throughout the Internet. It is composed of two areas: a header area

Figure 5.1: Prototype 1: minimalist web form

with the logo of the fictitious telecenter and the title of the service (on-line registration, "cadastro on-line" in Portuguese), and a central area with a four column form. The first column of the form contains an image in each row, displaying a question mark within a speech bubble. A click on this image will open a pop-up window with context sensitive help, i.e. an explanation of the related form field. The second column contains the field labels, the third column the fields themselves. The last column of the form contains the stylized image of a loudspeaker in each row. A click on this image will "read" the label of the associated form field.

The form has five rows for the fields "name", "date of birth", "ID", "tax payer's account number", and "address". The date of birth is split up into three form fields with the labels "day", "month" and "year". The last row of the form contains two image buttons, one with the image of an upright thumb and the label "send" ("enviar" in Portuguese) in uppercase letters and one with a twisted arrow pointing to the left (similar to the undo button in many desktop applications) and the label "cancel" ("cancelar" in Portuguese), also in uppercase letters. The "thumbs up" gesture is widely used in Brazil as a sign of approval or "everything is fine, OK".

The pop-up window with context sensitive help contains a short text of no more than 15 words explaining which data has to be filled in, an image of a document where this data can be found (e.g. the Brazilian ID card with a highlighted date of birth or an electricity bill with a box highlighting the address field). On opening the pop-up window, an audio file is played which reads the explanatory short text. The audio file can be replayed by clicking on the loudspeaker image.

A click on the "send" button displays a message asking for confirmation and a non-editable form displaying the data entered by the user. This form does not contain the help or loudspeaker column. It contains two image buttons, one with the image of an upright thumb and the label "confirm" and the other with the cancel button identical to the previous form. A click on the "confirm" button opens an OK dialog box with the message "data registered with success", a click on the "cancel" button returns to the previous form.

Navigation is possible via both mouse and keyboard ("tab" and "enter"). The prototype features no video in sign language but tries to assist deaf people through images with the context sensitive help.

5.2.3 Prototype 2 – registration wizard

Figure 5.2: Prototype 2: registration wizard

The layout of the second prototype (cf. Figure 5.2) is similar to that of content management systems. The header area contains the logo of the fictitious telecenter, a horizontal navigation bar, and an accessibility bar with breadcrumb links and buttons to increase or decrease the font size. A footer contains copyright information. The central area is made up of two parts, the left part – the service content area – where the actual service execution (the registration) takes place and the right part – the media area – that contains redundant audio or video presentations of content in the service content area along with controls to pause/continue video and audio files. The navigation bar contains one item for each step of the registration process: start, name, ID, phone, and confirmation. The initial page (step "start") shows a graphic representation of the main steps of this

process. The current step is highlighted in the navigation bar; non-mandatory fields can be skipped via a “skip” button, although navigation between steps is not possible.

On loading a page a corresponding video in sign language and an audio message are played back automatically. The video explains the current step (e.g. “type your name and hit ’enter’ or click on ’continue’”), i.e. each step has exactly one associated video in sign language. With exception of the final confirmation step, each step also has exactly one associated audio file that is played back upon loading the page and can be replayed by clicking on the play button of the audio control in the media area.

During each step, only one token of information is requested. An exception is the confirmation page, where all values can be edited “inline”: the page contains a table of all previously filled-in fields in rows of three columns (field label, field content, “alter” button). Initially, the field contents are read-only. On clicking the “alter” button, the field content changes into an editable text box and the “alter” button becomes a “confirm” button. Navigation in the prototype is possible via mouse or keyboard (“tab”, “enter”, and some keyboard shortcuts like “alt” + “o” to change the focus to the breadcrumb links).

5.2.4 Prototype 3 – assistive registration

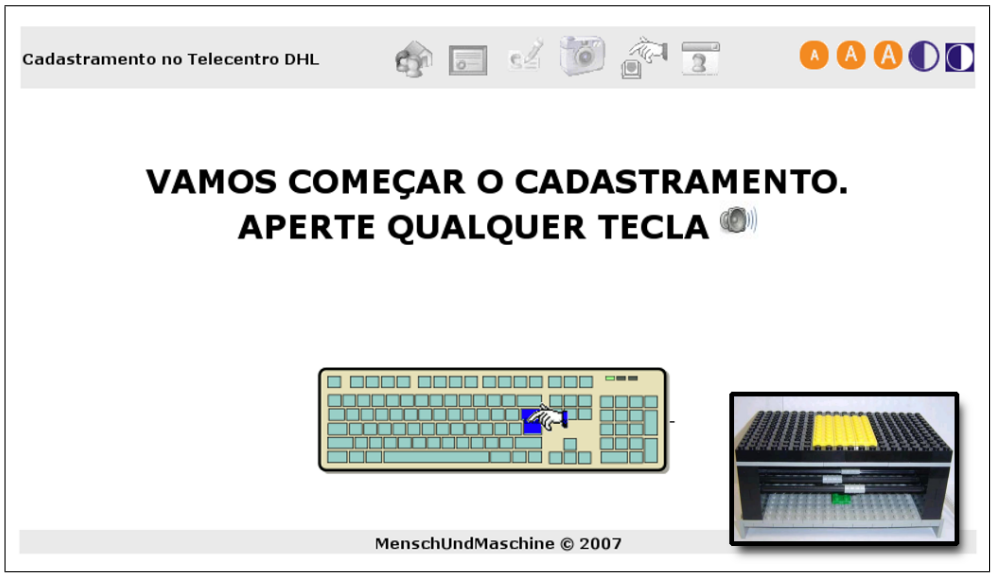

Figure 5.3: Prototype 3: assistive registration with additional hardware

The basic layout of the third prototype is similar to the second, but minimalist (cf. Figure 5.3). A header contains a service title (“telecenter registration” or “Cadastramento no Telecentro DHL” in Portuguese), image representations of the registration steps, and buttons to increase or decrease the font size and toggle the screen colors between the

regular and a high contrast version. The central content area is composed of 3 lines. The first line contains a short instruction for the user (e.g. "type your name"), the second line contains the "interaction area" with text fields, click buttons, etc. and the third line contains images or animations with hints regarding the execution of the current step. Below the central content area, a one-line footer contains copyright information. Each sentence on the screen has an associated image of a loudspeaker, which will "read" the respective sentence on a click.

On loading a page, the audio file corresponding to the sentence in the first line of the central content area is played back automatically. The interface contains no audio controls, i.e. for (re-)playing an audio file, the user has to click on the respective loudspeaker. The prototype uses additional hardware and software to facilitate the registration process, namely a scanner with OCR software to read information from an ID card or utility bill, a web cam to take a picture of the registrant, and a fingerprint reader to substitute a text based password. Furthermore, colored stickers have been affixed to the main function keys of the keyboard: a green sticker to the key "S" (port. "sim", engl. "yes" to confirm), a red one to "N" (port. "não", engl. "no" to negate), and a blue one on "Enter". The colors of the stickers on the keyboard match the colors used on the screen.

As in the second prototype, only one token of information is requested during each step. In contrast to prototype 2, the user has to confirm each piece of information before continuing to the next step. Alternatively, the user can return exactly one step to correct the single still unconfirmed piece of information. During the last step, a summary of all registered information is displayed.

Navigation is possible via mouse and keyboard ("enter", "s" and "n"), whereas the valid keys are always made explicit in the user interface via a graphical animation of a hand pressing the respective keys on a keyboard. The prototype does not feature videos in sign language. Instead, it tries to use graphical animations whenever possible (e.g. the message "put your right thumb on the reader" is represented by the animation of a thumb being put onto the fingerprint reader, whereas a photo of the "real" reader has been used).

5.2.5 Prototype 4 – registration kiosk

The last prototype has a tiled layout of four areas in two rows and two columns (cf. Figure 5.4). The uppermost left area – the content area – contains the fields to be filled in by the user. The uppermost right area contains the video area, the lower two areas contain an on-screen keyboard and video caption respectively. All areas except the content area can be collapsed and show a miniature view of their contents in the collapsed state.

To register on this prototype, only the fields "name" and "personal ID" are required. These are presented in the content area in two rows and a "<field label>: <text field>"

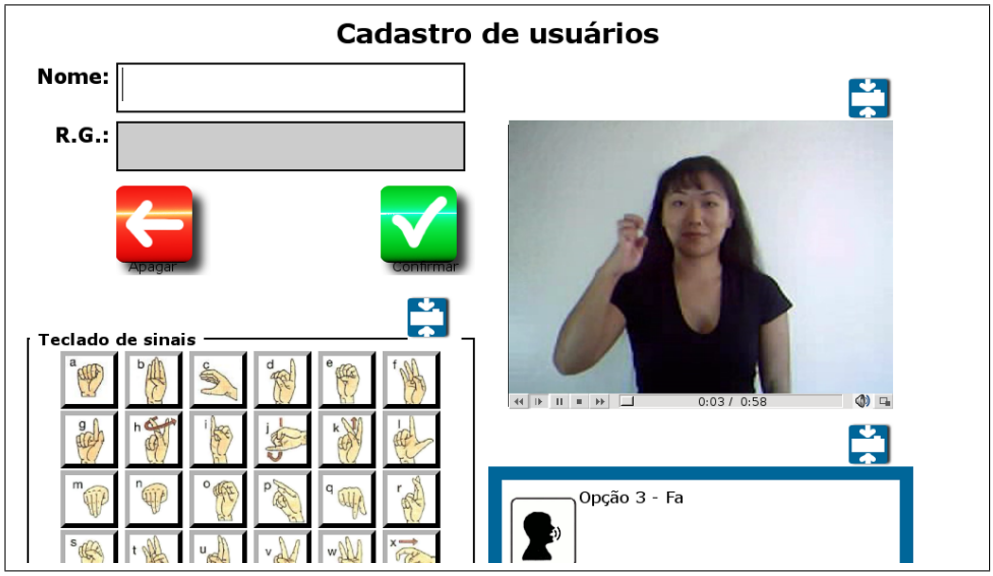

Figure 5.4: Prototype 4: registration kiosk

format. The fields can be filled-in using the regular or the on-screen keyboard. Below the input fields, a "delete" button can be used to delete the character before the cursor, and a "confirm" button can be used to conclude the registration. A click on this button results in the confirmation page that displays the registered information with a big image of a check mark along with a video that plays a confirmation message. As an alternative to typing his or her name and personal ID, the user can also register his or her fingerprint on a fingerprint reader or speak out aloud his or her name.

The videos of the prototype are in signed Portuguese with synchronized spoken language. Signed Portuguese differs from the Brazilian Sign Language insofar as it is an almost one-to-one translation of uttered words into signs and therefore generally does not follow the grammar of the Brazilian Sign Language. The video can be replayed using the video controls of the browser plug-in. The caption is synchronized to the video, i.e. written on the screen as the voice in the video "speaks". Since the caption area is restricted, only the caption associated with the current sentence of the video voice is displayed.

The on-screen keyboard has no QWERT, but an ABCDE layout. Each key contains a lowercase letter or digit and the corresponding sign of the Brazilian signed alphabet. The keyboard can only be used with the mouse. On clicking a key of the on-screen keyboard, the same image of the key (letter with sign) appears in the currently active text field of the content area. On hitting a key on the regular keyboard the display switches to character-only and vice versa. Navigation is possible using the regular keyboard ("tab" and "enter") or the mouse.

5.3 Analysis of the prototypes and discussion

Before analyzing the interaction of target user representatives with the four prototypes, we present a synthesis of solutions used in more than one prototype. We evaluate these common solutions based on the findings of related literature.

5.3.1 A literature informed analysis of the prototypes

Regarding multimedia content, all prototypes made use of different media in an attempt to make contents accessible or legible to users with different special needs. Visual media used in the prototypes are images, animations and videos, whereas some animations and videos are featured in sign language. Since none of these media were created by professional graphic designers or video artists, we do not evaluate the created artwork, but analyze the underlying ideas.

Regarding the adequacy of the format of the visual representation (drawing vs. graphic art vs. photo-realistic or photographic images; black and white vs. grayscale vs. color; animation vs. video) Medhi, Prasad & Toyama (2007) present some recommendations, but clearly there is no best solution or recipe for this question. The best characteristics of the visual representation seem to depend on the problem domain as well as on cultural aspects. Independently of the format of the visual representation, not all information can be represented by static imagery or animations without spoken or signed content. Thus, videos or animations in sign language are crucial resources for the deaf and hard hearing.

Kennaway, Glauert & Zwitserlood (2007) compare signing avatars with videos in sign language and reach the conclusion that signing avatars have significant advantages over videos in sign language. Yet, cultural aspects also have to be considered: our own activities with end user representatives have shown that they prefer videos with "real" people. However, further investigations will have to be undertaken to examine if this preference would impose a barrier to the interaction with an animated avatar. As to the question of providing synchronized videos with signed Portuguese or a video in spoken Portuguese for the hearing and a video in Brazilian Sign Language for the deaf and hard of hearing, we hypothesize the latter version is more adequate, since it respects the characteristics of both languages, spoken and sign language.

Regarding the representation of audio information, we can choose between concrete sounds, abstract sounds, natural speech and synthesized speech. In the context of eGov services, concrete sounds will be inapplicable most of the time (what sound does a tax declaration make?). Regarding abstract sounds, Brewster proposed "earcons" – "auditory icons" – as a technique to, for example, facilitate navigation in menus (Brewster 1998). While this is certainly a very interesting technique, the benefits for eGov services would be limited, since many eGov services will only be executed occasionally and abstract sounds

are hard to remember if not constantly used.

The use of natural vs. synthesized language finally depends on similar criteria as in the choice of the video format. Considering the user representatives preference towards videos with real people, our practice with the prototypes has surprisingly shown a high acceptance of synthesized speech. Since many of the user representatives were not exposed to the idea of a computer actually "speeking to them" before, this acceptance rate may be biased and further investigations are recommended.

When creating texts for the user interface, the designer can rely on guidelines from literature. Examples include those for making interfaces accessible to users with low literacy skills (Huenerfauth 2002) or to users with cognitive impairments (Sevilla, Herrera, Martínez & Alcantud 2007). For some languages even some "simple speech guidelines" exist (ILSMH European Association 1998) that recommend not using subjunctive tense, only covering one main idea per sentence, or using practical examples, among others.

All the prototypes tried to minimize the quantity of text on the screen. Prototypes 1 and 4 only use short field labels in the content area and longer texts in the context sensitive help or in the caption area respectively. Prototypes 2 and 3 try to use relatively simple sentences with few pieces of information per sentence. Nevertheless, the simplification of the vocabulary may be treated cautiously as it could negatively affect credibility and trust, two important requirements for eGov services.

Regarding the display of video captions, it has to be evaluated if those should be used the same way as television captions or if all text should stay visible all the time in a separate area of the interface. The latter option has two advantages. Users with low literacy skills could try to read the captions but fail because of their slow reading. If the text stays visible until the user chooses another video, users will be able to read the text without haste. The other advantage is that users with better literacy skills will be able to consult the text on the screen instead of being forced to replay the corresponding video in order to look up information that already slipped their auditory memory. A possibility to make the caption more useful to users with low literacy skills is to highlight the text in a karaoke-like manner synchronized to the spoken text.

Important questions that should be answered before editing texts, videos, or recorded or synchronized audio files are: Does the vocabulary have to be localized for users from different regions? Does spoken text have to be adapted in order to reflect regional dialects? Should texts be spoken or synthesized by female or male speakers or using female or male synthesizer voices? Should all texts be spoken by the same speaker? Are different sets of texts required in order to reflect differences between spoken and written language?

Leahy, Chandler & Sweller (2003) investigated the effects of redundancy of textual, visual, and auditory information on short time memory and found that in certain configurations, more redundancy can actually lead to poorer performance. This effect depends on

the complexity of the information, i.e. more complex information favors complementary instead of redundant information. However, it is not yet clear how the method to measure information complexity presented by Leahy et al. (2003) can be generalized to be applicable to web based electronic government services, nor if the threshold at which complementary information outperforms redundant information depends on the user profile. We believe however, that redundancy of textual, visual and auditory information could increase the accessibility or intelligibility of a given written text for users with low literacy skills, as well as for the deaf and hard of hearing. Thus, the complexity of information has to be kept sufficiently low.

Beyond common accessibility features like breadcrumb links, font size and contrast changing, the following assistive techniques were offered in the four prototypes: images, photos, animations, videos in Portuguese, videos in Brazilian Sign Language, audio files, simplified vocabulary, cursor focus on first form field, keyboard navigation, request one chunk per screen, on-screen keyboard, inline help, biometric identification or authentication (voice recognition, fingerprint reading), scanner with optical character recognition (OCR) software, character deletion with mouse, visible process.

"Cursor focus on first form field" means that, on loading a new page, the focus of the cursor is automatically set on the first form field on the screen. Regarding the amount of information the user needs to provide prototypes 2 and 3 request only one chunk per screen whereas prototypes 1 and 4 request multiple chunks, where one chunk can be composed of multiple form fields (e.g. date of birth). "Inline help" means the display of context sensitive help within the same page (e.g. prototype 4) as opposed to the display in a separate window (e.g. prototype 1). "Scanner with OCR software" does not simply mean the existence of the respective hardware device, but emphasizes that it is employed to assist the user in filling in the different form fields. "Visible process" in this case means that the different steps of the registration process are visualized on the screen, for example by a sequence of step labels or images in prototypes 2 or 3 respectively. Since it is difficult, if not impossible, to select images that carry the same meaning to all viewers, the approach of using additional text labels as in prototype 2 is preferable over the image-only approach of prototype 3.

It should be noted that some techniques that address certain special needs could have a negative effect on other special needs. Automatically starting audio or video playback will interfere with the use of a screen reader. The technique of only requiring one chunk of information per screen could have a negative impact on the performance of more experienced users with sufficient literacy skills, although those users would still be able to execute the respective service. This type of conflict could be resolved by user interface tailoring; a further analysis of this topic is out of the scope of this paper.

Some techniques are also highly application dependent. For a registration service which

will only be executed once by every user, requiring one chunk of information per screen may be adequate; however, this technique is perhaps not applicable to services that are executed repeatedly (e.g. searching articles that meet a set of certain criteria (topic, date, author, etc.) in an online library).

5.3.2 Analysis based on observing users' interaction

The four prototypes were used during an activity with end user representatives recruited from a Brazilian city. The majority of the residents of this neighborhood belong to the two lowest socio-economic classes. The activities as well as previous and subsequent activities with the same users were carried out in a telecenter located in the same place. The constitution of the group of users as well as a preliminary description of requirements and design guidelines derived from the analysis of abilities of these users have been described in detail elsewhere (Baranauskas, Hornung & Martins 2008, Neris, Martins, Prado, Hayashi & Baranauskas 2008).

Eleven users interacted with the four prototypes. They were given the task of registering themselves as new users of a fictitious telecenter using the four prototypes. After the interaction with each prototype, they were asked to fill in a simple form (did you register yourself successfully? was it easy? school grade for the registration, what did you like most? what did you like least?), whereas a facilitator assisted users who weren't comfortable to write by themselves. The interactions took place in four different stations each of which was equipped with laptop, mouse, speaker boxes, web cam, microphone and the additional hardware necessary for the execution of the prototypes. At each station, a facilitator and observers were present taking otes. The users were asked to think aloud during the interaction with the prototypes. Additional comments could be made during a collective discussion round.

The interactions were recorded using a screen capture tool, that also recorded web cam and microphone input. After each interaction with a prototype, the observers filled in a form registering quantitative (duration of interaction, successful registration) as well as qualitative data (which characteristics made the registration difficult/easy, did the user comment on anything, which strategy did the user employ, did any technical problems occur, other observations).

There was no time limit for the interactions and the users were instructed that they could quit at any time. The interaction times ranged from few seconds to 40 minutes, and not all users interacted with all prototypes.

Since we do not intend to conduct a quantitative analysis nor a comparable evaluation of the prototypes, we will present the results in a summarized and commented form and only refer to a specific prototype if a particular feature that is not present in other

prototypes had a significant effect on the interaction. Our analysis considers all collected data: the questionnaires filled in by each user for each prototype, the observation forms from each observer for each user and prototype, as well as the recorded videos, screen casts and comments during the final discussion round. We will not discuss aspects already covered by our analysis in the previous section or by common accessibility or usability guidelines (Nielsen 1993, W3C 2007).

As expected, some of the difficulties we observed are related to the users' skills with computers. We could observe this with peripheral devices (keyboard, mouse), as well as with user interface elements considered as basic knowledge (e.g. scroll bars, OK dialog boxes). Regarding mouse pointing, some users required great efforts to move the mouse pointer to a desired area on the screen. As to clicking, some users clicked firmly the left button while moving the mouse, which resulted in marking texts or images on the screen, or clicked the right button, which caused confusion when the context menu opened. The latter effect could be avoided disabling the right mouse button for the respective service.

Besides the mouse, users had also difficulties in using the keyboard. Some users pressed keys forcefully and enduringly which resulted in repetitions of the associated character, an effect that could be avoided turning off keyboard repeat. Other users got confused after accidentally pressing the CAPSLOCK key or did not know the backspace key or the space bar functions. Another observation in this context is that many of the users with no computer experience did not look at the screen when typing. Thus, they did not perceive key repetition, typos, or the fact that the form field they wanted to fill in did not possess the cursor focus.

Regarding interface elements, users with no computer experience had difficulties using scroll bars, e.g. they did not perceive the scroll bar on the right side of the screen and thus did not access content outside the visible area of the screen. Other problems occurred with dialog boxes, even if they only had one button, and with pop-up windows. Scroll bar and dialog box problems are directly related to mouse handling problems, the pop-up window problem however occurs because the user does not perceive that he or she can return by closing this window. Thus, we do not recommend the use of pop-ups. Finally some users got confused because the browser's form input history was not cleared between the interactions of two different users.

Some of the problems we just mentioned could be prevented by disabling or reconfiguring certain keyboard or mouse features. However, this could have a negative effect on users who already have some familiarity with computers and expect a certain behavior of peripheral devices or user interface elements.

Another example where simplifications intended to support users with no experience might negatively affect the interaction of users with more experience is related to filling in form fields. Some users expected an input validation or a hint regarding the input

format (e.g. personal ID with or without dots and dashes). When presenting fields with the labels "name" or "address", those users where uncertain if they were supposed to fill in first name and last name and or which components of the address they should provide. Furthermore they were uncertain if they were allowed to use upper and lower case letters and accentuation. However, we could not determine whether this behavior occurred because they recalled a web application that only accepted input without accents or because they remembered filling in a paper form. This observation is an indication that it is important for designers to be aware of real life experiences of users and the effect on the interaction with computer based services.

A similar immediate phenomenon was observed regarding the mutual effects of previous experience and interaction with the prototypes. Users who interacted with a prototype after having experimented prototype 3 (the one with color stickers on the keyboard), tried to use the "enter" key to proceed to the next step. Furthermore, possibly because prototype 3 established a strong mapping between colors and buttons in the interface and keys on the keyboard, users who interacted with other prototypes were looking for "start" and "confirm" keys on the keyboard. Thus, establishing strong conventions in one interface could have negative effects on the interaction with other interfaces. On the other hand, this shows that users with no computer experience can quickly adapt to conventions. Thus, on the background of the digital divide, we recommend following already established conventions regarding the current state of the art in interface design.

With regard to assistive techniques, we observed that many users did not perceive the context sensitive help of prototype 1. Thus, we recommend using inline help within the interface or strongly emphasize interface elements that provide help. In general, the users liked to have different possibilities to conclude the registration. However, one user expressed his dislike of the fingerprint reader. Since user acceptance and trust are very important in electronic Government services, this issue should be further investigated. Some users where uncertain, if their registration really had been successful, even when the interface presented a confirmation message. Regarding electronic government services, we thus recommend the possibility of printing out important messages (confirmation messages, order/process status, etc.).

An observation that may seem not very significant at first is that the users enjoyed to have their photo taken in prototype 3. In the spirit of Bødker's (2006) third wave of HCI and the research on the digital divide, it is important to create user interfaces that are fun to use and offer something that motivates the user to interact with the interface and more important to come back again later.

Among the strategies the users adopted to execute the task of registering themselves at the fictitious telecenter were: asking the facilitator, using the possibilities of embedded audio files and searching icons related to the desired task. The strategy of asking the

facilitator emphasizes the importance of trained personnel at the telecenters to assist the end users. These telecenter personnel need to have the required skills regarding the offered electronic services, and need to be aware of the users' different special needs. Finally, regarding the other two mentioned strategies – using embedded audio and searching related icons – the users expressed their preference for prototypes that enabled interaction without the need to write and that offered embedded audio or visual representations that minimized the need to read. Although the users would perhaps be able to use those interfaces, succeeding in the use of (electronic) government services, we do not recommend text-free interfaces or interfaces without any text input. From the point of view of digital inclusion not much would have been achieved, as they would be restricted to those types of interfaces.

5.4 A design rationale to support eGov interaction design

In this section we present a design rationale deduced from the literature informed analysis and practical observations made in the previous sections. In contrast to a design rationale about a concrete product, the design rationale presented here discusses abstract and invariant aspects of design issues present in eGov services. Since design decisions depend on the services and other context related information, we chose to present a design rationale instead of design guidelines.

The argumentation based design rationale presented here uses the graphical notation of Conklin's gIBIS (graphical Issue-Based Information System) which is in turn based on Kunz's and Rittel's IBIS (Issue-Based Information System (Conklin & Begeman 1988)). A discussion about a particular design problem starts with and issue (or question). For each issue, positions (or ideas) can be articulated that would resolve the issue. The positions do not have to be mutually exclusive, and each position may have one or more arguments that support (+) or refute (-) that position. We opted for the basic notation in order to increase the reusability and the understandability of our rationale.

Because of the spatial limits of this paper, we chose a tabular instead of a graphical presentation (cf. Table 5.1). Moreover, we do not repeat recommendations made in the previous sections, but only mention issues that require further reflection.

Table 5.1: The Design Rationale

Issue	Position	Argument
Service identification and authenticity	Use official logos and service names/ descriptions	+ users will recognize that they are on a government site + increase users' trust + service descriptions are often written in a language that is not understood by the users − not all government agencies/services have logos that are known to the user − the knowledge about off-line services that use the same logo might have a negative effect, if on-line and off-line processes differ or if the off-line process has a low user acceptance
	Create logos and service descriptions using methods of participatory design	+ logos of not-so-well-known services will make more sense + elaborate a vocabulary of terms that can be understood by the users + simplified descriptions may yield a better comprehension − oversimplified descriptions can have a negative impact on trust − replacing well established logos can confuse users
	Use SSL certificates	+ increase trust − users with no computer experience could get confused by browser messages (e.g. "this page contains unsafe objects", "certificate expired", etc.)

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Table 5.1 – continued from previous page

Issue	Position	Argument
Process	Display the location within a process in a format similar to a progress bar	+ easy identification of the current location within the process − a progress bar (e.g. "40%" or "step 2 of 5") could be meaningless for users with low computer experience
	Use images to represent steps of a process	+ users with low literacy skills will be able to identify their location within the process − for eGov processes, significant images could be hard to find − users with visual impairments will not be able to identify their location just by listening to image descriptions
Images, video and audio files	Use different media redundantly to textual information	+ users, especially those with low literacy skills, can rely on multiple sources to comprehend information − depending on the task complexity, redundancy can have a negative impact on the performance of users with sufficient literacy skills − users of screen readers could be annoyed by redundant information (i.e. when the screen reader reads text and image descriptions that contain the same information)
	Use media as complementary information to textual information	+ achieve better performance for services with higher task complexity − users cannot construct their understanding anymore by using redundant representations, but have to interpret all pieces of information correctly

Continued on next page

Table 5.1 – continued from previous page

Issue	Position	Argument
	Use media to substitute texts	− not always possible to find meaningful images − loss of trust by users with sufficient reading skills because of apparent oversimplification − manifest exclusion of people with low literacy skills and computer experience, because they will not be able to "grow" and use text-based services
	On loading a new page, automatically play back default audio or video file	+ good assistive technique for users with low literacy skills − experienced users with sufficient reading skills could be annoyed
Login/User authentication	Use user name/password or similar data and standard login mechanisms	+ users with low computer experience can get used to standard login mechanisms widely found in the internet − user name and password might not make sense to users with low computer experience − password recovery mechanisms (e.g. send new password to email address) could not work (e.g. user does not have email address, nor does he know how to use an email client) − if services are not used on a frequent basis, the user might forget the password

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Table 5.1 – continued from previous page

Issue	Position	Argument
	Use physical access tokens (e.g. smart card)	± enable service use by a proxy (e.g. child or other relative) − danger of abuse if only means of authentication − if services are not used on a frequent basis, higher probability of loss of access token − necessary hardware might not be available at all access points
	Use biometric methods	+ lower probability of abuse ± no use by proxies − negative effect on acceptance because of privacy concerns (e.g. fingerprint scanned by government agency; stigmata of using fingerprint in some subcultures) − necessary hardware might not be available at all access points
Data entry	Use scanner/OCR software, barcode readers	+ users with low literacy skills will be able to enter data − scanning data from private documents can conflict with the user's privacy − the necessary hardware might not be available at the user's home, nor in all telecenters
	Instead of using scanners, etc., offer visual hints, e.g. an image of a utility bill with a highlighted address area	+ users with low literacy skills could be able to copy simple data like name, telephone or address + users with low computer skills can familiarize themselves with the keyboard which will help them using other applications − users with no computer skills could not know keys like backspace, space, shift, etc.

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Table 5.1 – continued from previous page

Issue	Position	Argument
	Request one chunk of information per screen	+ supports users with low literacy or computer skills, who could be intimidated by big forms − negative effect on performance of experienced and frequent users
	Request multiple chunks per screen, but try to not exceed the size of the visible screen to avoiding scroll bars	+ good compromise between "one chunk per screen" and "one screen only" − users could get confused if unrelated chunks of data are requested on the same screen − considering users with low literacy skills, it is not clear how to determine the optimal number of chunks per screen
	Display chunks on the same screen as they are requested (e.g. with AJAX)	+ users will have an overview of what they already entered + the current chunk can be clearly highlighted − unclear how to ensure accessibility for users with visual or cognitive impairments

The positions and arguments in Table 5.1 can be traced back to the literature and prototype analysis. The use of biometric identification devices, for example, has been discussed in eGov related literature (Hornung, Baranauskas & Tambascia 2008) and was commented by some of the end user representatives.

"Service identification and authenticity" in Table 5.1 addresses the question of how users can identify that they actually are executing the eGov service they want to. Many eGov services are procedurally organized. "Process" deals with the question of how to communicate the information of what steps are required to execute the process, which steps have already been done, etc. The issue "Images, video and audio files" deals with the use of different media on a web page, "Login/User authentication" relates to the different possibilities to authenticate the user. Finally, "Data entry" deals with possibilities on how to facilitate the entry of data by users.

Some of the issues presented in Table 5.1 can be answered differently depending on the particular context we are designing for. Regarding data entry, the scanning of an income

declaration issued by the employer would certainly facilitate the income tax declaration, whereas the scanning of a phone or utility bill in order to complete a registration process would unnecessarily capture private data that could lower user acceptance. In some cases, the evaluation, whether an argument is in favor or against a certain position, depends on the policies or norms within the context of the application (e.g. enabling applications to be used by proxies; arguments marked with "±").

Design decisions usually require compromises to be made. Issues that have contradicting positions (e.g. "Data entry") several of which would favor certain user competencies impose challenges on interface flexibility (e.g. how to present data entry forms for users with different special needs considering the principles of Universal Design).

5.5 Conclusion

Whereas there exists a substantial amount of literature about accessibility regarding visually and physically impaired users, literature about interface solutions for users with low literacy skills is hardly existent. This issue is especially relevant for the context of eGov applications in countries with a huge diversity in users' capacities and skills regarding the access to information through technology. While this is a fundamental problem in developing countries, it is also a relevant problem in developing societies, which for example have to provide eGov access for immigrants.

This paper has analyzed this problem using the Brazilian scenario of diversity of users, as a way of facing the challenge proposed by the Brazilian Computer Society regarding the "participatory and universal access to knowledge for the Brazilian citizen". We looked at the problem and investigated potential solutions under the interaction design and interface features perspective.

We have shown how the design of a registration service, informed by literature findings related to issues on societal interfaces, can be used by representative users in the research scenario. Based on analysis of the interaction of end user representatives with four low-fidelity but executable prototypes, this paper presented an abstract Design Rationale for inclusive eGov services. We chose to represent our findings through a Design Rationale, instead of a set of design guidelines, as it supports and expresses more directly context-dependent design decisions. Moreover, our goal was not to communicate concrete design decisions, but to support designers in their process of reflecting about alternatives and deciding which alternative(s) are the most suitable in their respective social contexts.

The Design Rationale was applied in the design of eGov services being tested, and is now being used in the design of an inclusive social network for citizenship in our country.

Capítulo 6

Conclusão e Trabalhos Futuros

Desenhar interfaces de usuário para serviços de eGov de uma maneira que facilite o acesso dos cidadãos Brasileiros requer uma abordagem que difere das abordagens tradicionais utilizadas para interfaces de outras aplicações web. No Capítulo 2 vimos que serviços do eGov têm que alcançar a população inteira, isto é cidadãos com diferentes competências e necessidades. Os requisitos para serviços de eGov podem ser diferentes do requisitos de outras aplicações web e podem ter outras prioridades. Confiança e credibilidade por exemplo são requisitos essenciais para serviços de eGov. Por outro lado, alguns requisitos voltados à eficiência do uso ou *performance* do usuário nem sempre são tão importantes, por que a freqüência de uso de alguns serviços é baixa. Quanto à execução de projetos de eGov, mostramos que problemas muitas vezes surgem por que métodos e técnicas empregados que foram bem sucedidos em outros contextos, como o contexto empresarial ou como o contexto de países já desenvolvidos, são aplicados sem adaptá-los ao contexto especifico. Identificamos que o envolvimento de representantes dos usuários finais é condição necessária para o sucesso de serviços de eGov.

Em seguida abordamos a questão de como facilitar o acesso dos cidadãos aos serviços de eGov. Mostramos no Capítulo 3 algumas falhas de tecnologias assistivas que originam intrinsecamente das definições do termo "tecnologia assistiva" que são voltadas à pessoas com deficiências e muitas vezes ao contexto de trabalho e ao uso freqüente e estacionário. Conseqüentemente algumas tecnologias são inapropriadas para nosso contexto pois, por exemplo, exigem conhecimento prévio dos usuários ou são incompatíveis com o ambiente físico em um telecentro. Propusemos a definição de "técnicas assistivas" que se estende a diferentes contextos de uso e aos usuários com competências e necessidades quaisquer (inclusive baixo letramento, baixo letramento digital e deficiências). Descrevemos algumas dessas técnicas que são soluções potencialmente adequadas ao nosso contexto. Essas técnicas podem ser diretrizes ou princípios de *design* mas também adaptação de soluções existentes como teclados com marcações especiais.

Essa mudança do contexto de uso de tecnologias e dos perfis dos usuários é descrito pelo conceito de "terceira onda de IHC": o uso da tecnologia acontece em várias situações da vida, a forma de uso não é mais somente racional e para fins bem definidos e o perfil dos usuários não é mais limitado para profissionais com experiência no uso do computador. No Capítulo 4 mostramos através do conceito de *societal interfaces* um caminho como pode ser feito o design da interação para sistemas que afetam diferentes áreas de uma sociedade (por exemplo cidadania, saúde ou qualidade de vida em geral). O *framework* proposto faz uso de métodos e técnicas da Semiótica Organizacional (SO) e do Design Participativo (DP) e segue os princípios do Design Universal. Um elemento essencial desse *framework* são as Práticas Participativas Inclusivas (PPI), onde os métodos da SO e do DP são aplicados. Através das PPI's é possível chegar mais perto do usuário final, e para capturar a diversidade do conjunto dos usuários – os cidadãos Brasileiros – criamos o Cenário*, um microcosmo da sociedade Brasileira que visa representar o conjunto o mais abrangente possível de competências e necessidades dos cidadãos. Devido às implicações da 3ª. onda identificamos como um desafio para trabalhos futuros a necessidade de repensar métodos tradicionais da área, por exemplo métodos da avaliação de interface do usuário.

Um elemento recorrente durante essa dissertação foi a percepção de que mesmo em um contexto bem definido como o nosso (serviços inclusivos de eGov para cidadãos Brasileiros) não há uma solução única para os problemas tratados. Os protótipos apresentados no Capítulo 5 mostram isso. Partindo do mesmo problema e de interesses e conhecimento semelhantes, as equipes chegaram em quatro protótipos bem diferentes. Portanto, quando avaliamos os protótipos no Capítulo 5, resolvemos não fechar essa análise com um conjunto de diretrizes ou recomendações, mas com um *design rationale*. A vantagem dessa abordagem é que as decisões de design ficam explícitas e não são reduzidas a um problema e uma "resposta"; dessa maneira um reuso em outros contextos é possível. O *design rationale* deixou claro que mesmo dentro do nosso contexto, decisões de design podem ser diferentes para diferentes serviços de eGov.

Resumindo, este trabalho mostrou como o design da interação para serviços de eGov pode ser feito de uma maneira mais inclusiva, para alcançar mais e discriminar menos cidadãos. Vimos que por causa das dependências culturais e outras não há uma "solução" única. para os problemas que enfrentamos, mas mostramos uma maneira de abordar esses problemas. Não alegamos ter resolvido o problema de criar interfaces totalmente acessíveis e evidentemente nem o problema da inclusão digital. Mas acreditamos ter contribuído ao esclarecimento de alguns requisitos necessários. Mais além formulamos novas perguntas para trabalhos futuros e continuidade da pesquisa.

Quanto a uma reflexão crítica deste trabalho, podemos identificar as seguintes questões:

1. Métodos da Semiótica Organizacional e do Design Participativo surgiram dentro do contexto empresarial. Esses métodos relativamente complexos podem ser aplicados

em um Cenário* onde participam pessoas com uma escolaridade baixa ou necessidades especiais?

As atividades durante as Práticas Participativas Inclusivas (PPI's) mostraram que é possível aplicar esses métodos e que os resultados são ricos. Contudo, nem todos os métodos e técnicas podem ser aplicados e alguns têm que ser adaptados ao contexto. Os artefatos usados em uma oficina semio-participativa por exemplo podem precisar ser simplificados. Nas PPI's ficou evidente, que os participantes fizeram valiosas contribuições sem conhecer o referencial da Semiótica Organizacional. Dependendo do perfil dos participantes, alguns métodos têm que ser adaptados, por exemplo o *BrainWriting* com pessoas com baixo letramento ou deficiência visual precisa de um facilitador que escreva. Já o *BrainDrawing* seria mais difícil, por que um fator importante é a espontaneidade e o tempo preciso para "traduzir" um desenho para uma pessoa cega pode afetar a espontaneidade dos outros participantes. Ainda assim, é possível pensar um *BrainDrawing* em duplas onde pelo menos 1 elemento da dupla seja vidente.

2. Ao invés de usar princípios do Design Universal, não seria melhor criar diferentes interfaces para diferentes necessidades, por exemplo um terminal para pessoas com baixo letramento?

   Essa questão tem dois ângulos. Do ponto de vista de um usuário com baixo letramento e pouca experiência no computador pode ser interessante ter uma interface simplificada e sem texto, instalado em um artefato físico especialmente criado para esse serviço (analogamente à urna eletrônica). Nessa interface ele poderia executar um serviço simples sem enfrentar a barreira de usar um computador com teclado e uma tela cheia de texto. Do ponto de vista de uma agência governamental o mesmo cenário pode ser desejável por que permitiria uma alta eficiência do serviço. Entretanto, para que esse cenário não tenha um efeito-colateral negativo à inclusão digital (o usuário só seria capaz de executar o serviço oferecido no terminal mas nenhum outro serviço oferecido pela Internet ou outros canais e assim ficaria discriminado e excluído), é preciso pensar na solução simplificada como um estágio elementar da mesma solução de interação na plataforma web, para que o usuário consiga evoluir de uma para a outra de forma suave.

3. Um Cenário* de 10 até 15 pessoas é muito pequeno. Ele realmente pode representar a população Brasileira? Não seria melhor um cenário com um número muito maior do que 15 pessoas?

   Do nosso ponto de vista o importante é a diversidade capturada no Cenário* e a qualidade dos resultados obtidos das PPI's. O envolvimento de um número grande de

usuários finais em vez de um número pequeno de representantes dos usuários finais, pode ser útil para validar posteriormente se o que fizemos foi efetivo, e de fato é recomendável fazer testes de aceitação com um número maior de usuários. Durante o processo de design todavia o valor de um resultado como "17% dos usuários gostaram da caixa azul na página login.html, 23% deles têm uma deficiência visual, e 63% deles moram na zona rural"é bastante limitado. Os PPI's são muito intensos e ricos e o tamanho do grupo de 10 a 15 mostrou-se ideal.. Além disso, um Cenário* de 10 a 15 pessoas ainda pode ser estendido para acomodar adicionalmente pessoas com perfis especiais para certas atividades.

4. Na prática corrente, serviços de eGov são geralmente implementados de cima para baixo. Dessa maneira, um serviço pode ser inclusivo? Oferecer serviços do eGov pode realmente contribuir à inclusão digital?

   Mostramos em nosso trabalho, como satisfazer requisitos necessários à criação de interfaces de usuário de serviços inclusivos de eGov. Uma interface de usuário criada dentro desta proposta possibilitaria o acesso de pessoas com várias necessidades específicas de forma não discriminativa. O serviço seria potencialmente inclusivo dado que representantes dos usuários finais teriam sido envolvidos no processo de design. Entretanto, para um sentido mais amplo à inclusão digital ainda falta um aspecto a considerar: a questão da pragmática, ou seja, motivação de uso. Possibilitar o acesso não significa que o cidadão usará o serviço. Para isso, o serviço tem que oferecer algo para o usuário que seja mais valioso do que executar o mesmo serviço *off-line* ou mais valioso do que não executar um serviço que não existe *off-line*. Discutimos brevemente essa questão no próximo parágrafo quando apontamos trabalhos futuros.

As questões ainda em aberto dos Capítulos 2 a 5 dão espaço para trabalhos futuros. No Capítulo 2 identificamos *gaps* com relação aos diferentes contextos nacionais e culturais. No Capítulo 4 mostramos alguns exemplos de como métodos tradicionais podem ser adaptados ao nosso contexto. Um trabalho interessante seria a instanciação de mais métodos da SO e do DP no contexto de uma PPI, visando as diferentes necessidades especiais e o perfil "não-computacional" dos participantes. Com relação aos Capítulos 3 e 5 sugerimos a extensão do conjunto das técnicas assistivas e do *design rationale* e a validação do rationale e das técnicas propostos, em outros contextos. Os conflitos de design apontados em vários Capítulos abrem espaço para a pesquisa na área do Design Universal e do Tailoring ou seja flexibilidade de interfaces.

Além de dar continuidade ao trabalho iniciado nesta dissertação, um próximo passo pode ser a elaboração de questões da inclusão. Para começar podemos nos inspirar tanto na proposta do design socialmente responsável quanto nas referências que foram citadas na introdução e que não entraram como texto nesta dissertação: a área da informática

comunitária oferece um potencial para se criar sistemas inclusivos, por que o sistema é criado pela própria comunidade segundo as necessidades dela. Entre outros, desafios nessa área são a escalabilidade e sustentabilidade de sistemas. Em termos de design, uma proposta interessante e a da Löfstedt (2007), que visa aplicar métodos do *social systems design* para a criação de serviços locais de eGov, isto é serviços de eGov no nível micro (e.g. prefeitura ou bairro). Nessa abordagem mais radical o próprio usuário se torna designer e ele é responsável pela criação de artefatos e pela agregação e multiplicação do conhecimento sobre design na comunidade. Se essa abordagem parece utópica ao leitor queremos lembrar que é só a continuação conseqüente da idéia da cultura digital mencionada no Desafio 4 da SBC.

Para finalizar este trabalho propomos investigar a questão da pragmática do uso de serviços de eGov ou mais geralmente as questões de IHC no *pragmatic web*. O terceiro nível do eGov é o da participação. Entretanto, podemos observar uma tendência em muitos países de os cidadãos não mostrarem interesse em participar em eleições ou outros processos democráticos. Usando métodos da Semiótica Organizacional podemos tentar esclarecer a questão de por que um usuário não está usando um serviço ou por que ele usaria um serviço. A mesma questão vale para outras aplicações web. A elaboração de questões pragmáticas pode talvez estabelecer uma conexão entre a web semântica e as redes sociais que apesar do nome ("social") podem não favorecer a inclusão digital, enquanto alguns usuários não têm acesso aos serviços ou não têm uma motivação para usá-los e por que os serviços não fazem sentido para eles.

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Apêndice A

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An: "Karin Breitman" <karin@inf.puc-rio.br>
Kopie: "Cecilia Baranauskas" <c.baranauskas@gmail.com>, "Heiko Hornung" <heiko.hornung@gmail.com>
Betreff: Re: Autorização
Datum: 01.10.2008 01:36:32

Muito obrigada pela resposta Karin!
[]s

2008/9/30 Karin Breitman <karin@inf.puc-rio.br>

> Cecilia
>
> Neste caso so e necessario notificar a SBC, o que ja esta feito
> []s
> karin
>
> On Sep 26, 2008, at 4:29 PM, Eventos - SBC wrote:
>
> > Prezada Karin
> > Estou redirecionando esta mensagem, pois não sabemos qual procedimento devemos tomar.
> > Pode nos orientar?
> >
> > Att
> > Jules Pacheco
> >
> > -------- Mensagem original --------
> > Assunto: autorização
> > Data: Thu, 25 Sep 2008 15:35:39 -0300
> > De: Cecilia Baranauskas <c.baranauskas@gmail.com>
> > Para: sbc-eventos@sbc.org.br
> > CC: Cecilia Baranauskas <c.baranauskas@gmail.com>, Maria Cecília Calani Baranauskas <cecilia@ic.unicamp.br>,
> > Heiko Hornung <heix@gmx.com>, Gabriela Conceição <gabi@sbc.org.br>
> >
> >
> > Prezada Adriana,
> > Estamos precisando de autorização da SBC para que nossos dois artigos publicados nos SEMISH de 2007 e 2008 [títulos
> > abaixo]sejam utilizados no corpo da dissertação de Heiko Hornung, meu orientado de mestrado no IC UNICAMP.
> > Semish 2007: Interaction Design in eGov systems: challenges for a developing country
> > Semish 2008: Design Socialmente Responsável: Desafios de Interface de Usuário no Contexto Brasileiro.
> > Aguardamos sua resposta asap e agradecemos desde já,
> > Cecilia
> > --
> > Profa. M. Cecilia C. Baranauskas
> > IC UNICAMP
> > --
> > Atendimento aos Coordenadores de Eventos
> > Sociedade Brasileira de Computação - SBC
> > Caixa Postal 15012 CEP 91501-970 Porto Alegre RS Brasil
> > Tel: +55 51 3308 7742 Fax: +55 51 3308 7142
> > E-mail: sbc-eventos@sbc.org.br

--
Cecilia

Von: "ICEIS Secretariat" <secretariat@iceis.org>
An: "'Heiko Hornung'" <heix@gmx.com>
Kopie:
Betreff: RE: Incorporation of ICEIS article into master thesis
Datum: 16.07.2008 13:56:34

Dear Heiko,

I give you the permission to use the mentioned paper in your MSc thesis as long as it is clearly stated that the paper has been published in ICEIS 2008.

Best Regards,
Vitor Pedrosa

-----Original Message-----
From: Heiko Hornung [mailto:heix@gmx.com]
Sent: sexta-feira, 11 de Julho de 2008 14:15
To: secretariat@iceis.org
Subject: Incorporation of ICEIS article into master thesis

Dear sirs,

at this year's ICEIS I presented the article "Assistive Technologies and Techniques for Web Based eGov in Developing Countries -- A Brazilian HCI perspective" (paper no. 568). As the author of the paper I would like to incorporate it into my MSc thesis. In the copyright form I signed it is stated that "The Author retains the rights to publish the contribution in his/her own web site or in his/her employer's web site, as long as it is clearly stated that the contribution was presented at ICEIS 2008 and a link to the ICEIS web site is made available there. Does this cover the use within an MSc thesis given that the respective section is clearly marked as an article that was presented at ICEIS 2008, etc.? Regardless of the answer to this question, my university most probably requires a written permission (letter, maybe fax is OK) from the publisher (INSTICC). Could you point out a person at INSTICC to whom I can send this request?

Thanks in advance and best regards,
Heiko