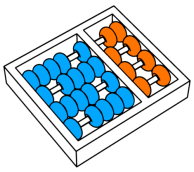

Roberto Romani

"Jogos com Propósito e Construção de Conhecimento em Design"

CAMPINAS
2013

Universidade Estadual de Campinas
Instituto de Computação

Roberto Romani

"Jogos com Propósito e Construção de Conhecimento em Design"

Orientador(a): **Profa. Dra. Maria Cecília Calani Baranauskas**

Tese de Doutorado apresentada ao Programa de Pós-Graduação em Ciência da Computação do Instituto de Computação da Universidade Estadual de Campinas para obtenção do título de Doutor em Ciência da Computação.

ESTE EXEMPLAR CORRESPONDE À VERSÃO FINAL DA TESE DEFENDIDA POR ROBERTO ROMANI, SOB ORIENTAÇÃO DE PROFA. DRA. MARIA CECÍLIA CALANI BARANAUSKAS.

Assinatura do Orientador(a)

CAMPINAS
2013

Ficha catalográfica
Universidade Estadual de Campinas
Biblioteca do Instituto de Matemática, Estatística e Computação Científica
Maria Fabiana Bezerra Muller - CRB 8/6162

R661j

Romani, Roberto, 1971-
Jogos com propósito e construção de conhecimento em design / Roberto Romani. – Campinas, SP : [s.n.], 2013.

Orientador: Maria Cecília Calani Baranauskas.
Tese (doutorado) – Universidade Estadual de Campinas, Instituto de Computação.

1. Interação humano-computador. 2. Design participativo. 3. Sociedade do conhecimento. 4. Computadores e civilização. I. Baranauskas, Maria Cecília Calani,1954-. II. Universidade Estadual de Campinas. Instituto de Computação. III. Título.

Informações para Biblioteca Digital

Título em outro idioma: Games with a purpose and the construction of knowledge in design
Palavras-chave em inglês:
Human-computer interaction
Participatory design
Knowledge society
Computers and civilization
Social computing
Human computation
Área de concentração: Ciência da Computação
Titulação: Doutor em Ciência da Computação
Banca examinadora:
Maria Cecília Calani Baranauskas [Orientador]
Anamaria Gomide
Maria Fátima Ridolfi Pires da Silva
Laura Sánchez García
Junia Coutinho Anacleto
Data de defesa: 13-12-2013
Programa de Pós-Graduação: Ciência da Computação

TERMO DE APROVAÇÃO

Tese Defendida e Aprovada em 13 de dezembro de 2013, pela Banca examinadora composta pelos Professores Doutores:

Profª. Drª. Laura Sánchez Garcia
SCE / UFPR

Profª. Drª. Junia Coutinho Anacleto
DC / UFSCar

Profª. Drª. Anamaria Gomide
IC / UNICAMP

Profª. Drª. Maria de Fátima Ridolfi Odine Pires da Silva
CGU / UNICAMP

Profª. Drª. Maria Cecília Calani Baranauskas
IC / UNICAMP

Instituto de Computação
Universidade Estadual de Campinas

Jogos com Propósito e Construção de Conhecimento em Design[1]

Roberto Romani

13 de dezembro de 2013

Banca Examinadora:

- Profa. Dra. Maria Cecília Calani Baranauskas (*Orientador*)
- Profa. Dra. Anamaria Gomide
  Instituto de Computação - UNICAMP
- Profa. Dra. Maria Fátima Ridolfi Pires da Silva
  Coordenadoria Geral da Universidade - UNICAMP
- Profa. Dra. Laura Sánchez García
  Setor de Ciências Exatas - Universidade Federal do Paraná
- Profa. Dra. Junia Coutinho Anacleto
  Departamento de Computação - UFSCar

[1]Suporte financeiro de: Projeto E-cidadania (processo Fapesp-MSR 2007/54564-1) e EcoWeb (processo CNPq 560044/2010-0)

Resumo

Nos últimos anos, as novas tecnologias de informação e comunicação têm modificado a natureza da interação humano-computador, quebrando os limites do contexto de trabalho para fazer parte da vida cotidiana das pessoas em todos os lugares e em qualquer momento. Assim, novos sistemas disponíveis por meio da Web e de dispositivos móveis estão ao alcance de um número cada vez maior de pessoas, aumentando a importância de se projetar interfaces para todos. Ainda, o desafio número quatro proposto pela SBC se alinha a essa necessidade de viabilizar o acesso do cidadão comum ao conhecimento de forma participativa e universal. Embora várias normas, recomendações e diretrizes tenham sido utilizados para auxiliar designers na complexa tarefa de projetar interfaces para todos, grande parte das escolhas ainda dependem muito da experiência do designer que, nesse cenário, não tem mais um público-alvo bem definido. Ao mesmo tempo, uma cultura de participação, desencadeada por ideias de *crowdsourcing*, computação social e computação humana, vem permitindo novas formas de colaboração para resolver problemas diversos. Esta tese propõe mecanismos que a um só tempo envolvem o cidadão comum no processo de construção do conhecimento em design e oferecem recursos que podem ser apropriados pelos designers em seu processo criativo de projetar interfaces para todos. Dessa forma, esta tese propõe, desenvolve e experimenta a abordagem GWIDO (*Games With Interaction Design Objective*), beneficiando-se de recursos oferecidos pela Web contemporânea, bem como do interesse das pessoas por jogos na internet. A ideia central consiste no uso de GWAPs (*Games With a Purpose*) para apoiar o designer na escolha de elementos de design, envolvendo nesse processo um grande número de potenciais usuários. A tese traz contribuições na interseção das áreas de pesquisa da computação humana e da computação social, mostrando um levantamento preliminar dos trabalhos relacionados, ilustrando a ideia com uma instanciação de um ambiente para designers integrado a um jogo do tipo GWAP e demonstrando a utilização da metodologia proposta de maneira prática no redesign de um sistema real.

Abstract

In recent years, new information and communication technologies have changed the nature of human-computer interaction, breaking the boundaries of the workplace to be part of the everyday people's lives in everywhere and at any time. Thus, new systems available through the Web and mobile devices can be used by a growing number of people, increasing the importance of designing interfaces for all. In addition, one of the challenges (number four) proposed by SBC is aligned to this need of improving the access of ordinary citizens to knowledge in a participatory and universal way. While several standards, recommendations and guidelines have been used to assist designers in the complex task of designing interfaces for all, most choices still rely strongly on the experience of the designer who, in this scenario, no longer has a well-defined target audience. At the same time, a culture of participation triggered by ideas of crowdsourcing, human computation and social computing has enabled new forms of collaboration to solve various problems. This thesis proposes mechanisms that involve ordinary citizens in the process of knowledge construction in design and in the same time offers resources that can be appropriated by designers in the creative process of designing interfaces for all. Thus, this thesis proposes, develops and experiences the GWIDO approach (Games With Interaction Design Objective), taking advantage of features offered by contemporary Web as well as the interest of people for games in the internet. The main idea is to use GWAPs (Games with a Purpose) to assist the designer in the choice about design elements, involving a large number of potential users. The thesis provides contributions at the intersection of research fields (human computation and social computing), showing a preliminary survey of the related work, illustrating the idea with an instantiation of an environment for designers integrated with a GWAP game and demonstrating the use of the proposed methodology in a practical way during a redesign of a real system.

Agradecimentos

Muitas pessoas contribuíram de forma direta ou indireta para tornar a conclusão dessa tese possível. Não vou citar nomes pois, fatalmente esqueceria alguém. Entretanto, gostaria de registrar aqui meu agradecimento a todos que, durante esses longos anos de doutorado, conviveram comigo e me apoiaram quer seja na Unicamp, mais especificamente, no IC, no NIED, no CCUEC ou no GGTE, quer seja fora da Unicamp, nas horas de dedicação aos estudos, nos trabalhos das disciplinas, nas madrugadas de escrita de artigos, nos eventos onde apresentei artigos e, porque não, nos momentos de descontração dos *happy hours* comemorativos de cada conquista.

Gostaria de agradecer, de maneira muito especial, à querida Professora Cecília, ao Grupo InterHAD e a todos os colegas doutorandos, mestrandos e alunos de iniciação científica com quem tive o prazer de conviver durante todo o período do meu doutorado, principalmente nas reuniões semanais organizadas pela Professora Cecília. Aprendi muito com todos vocês!

Em especial gostaria de agradecer também a meus pais que me deram todas as condições para que eu chegasse até aqui.

Não poderia deixar de registrar também meu agradecimento carinhoso a minha esposa Luciana, e aos meus filhos Lucas e Rafael pela paciência, compreensão e apoio durante todo o período do doutorado.

"A atenção é a mais importante de todas as faculdades para o desenvolvimento da inteligência humana."

Charles Darwin

Sumário

Lista de Tabelas

Lista de Figuras

Capítulo 1

Introdução

Desde o início das pesquisas em Interação Humano-Computador (IHC), designers de aplicações interativas têm usado diversas técnicas para entender as tarefas dos usuários, suas necessidades e potenciais novos recursos que poderiam melhorar essas tarefas. Embora essas técnicas estejam sendo constantemente aperfeiçoadas, o desafio tem aumentado especialmente devido ao desenvolvimento de novos dispositivos computacionais móveis, à evolução da web e consequente à diversidade de usuários.

Quando o escopo de uma aplicação é bem definido e o conjunto de usuários potenciais é limitado e homogêneo, os designers podem usar técnicas tradicionais de IHC para escolher elementos, representações e metáforas, na interface de usuário, em sintonia com os perfis dos usuários. No entanto, o design de interação torna-se mais difícil, à medida que a diversidade de classes de usuários aumenta. Neste contexto, um novo suporte é necessário para o processo de design de modo a captar não só essa diversidade de usuários, mas também, como eles interpretam os elementos, representações e metáforas.

Considerando-se sistemas computacionais com o objetivo de alcançar uma variedade muito grande de usuários podemos incluir os que utilizam a abordagem do *Design For All* ou Design Universal (DU) [NCSU, 2008]; essa abordagem ao design propõe não discriminar na interface categorias de usuários; isto é, a interface deve ser projetada para todos os usuários independentemente de eventuais limitações sensoriais, físicas ou cognitivas que eles possam apresentar, seja de maneira temporária ou perene.

Ainda, de acordo com as boas práticas de IHC, o usuário é o *stakeholder* mais indicado para validar as interfaces projetadas pelos designers, bem como para contribuir no processo de design. Esse envolvimento do usuário é tradicionalmente feito por meio de métodos convencionais de design centrados no usuário [Norman e Draper, 1986] ou de design participativo [Schuler e Namioka, 1993]. Entretanto tais práticas foram originalmente pensadas para contextos específicos como ambiente empresarial ou de chão de fábrica onde o número de classes de usuários é pequeno e homogêneo. Assim, para os

usuários que não estiverem representados nesses grupos, os designers tem que escolher os elementos de interface com base unicamente em sua própria experiência.

Por outro lado, a Web oferece recursos que podem ser usados como mecanismos eficientes de acesso "ilimitado" às diferentes classes de usuários em todo o mundo. Um bom exemplo de envolvimento de diferentes usuários, fornecendo informações coletivamente, são os softwares sociais cujas aplicações mais conhecidas são as redes sociais, *wikis* e *blogs*. O termo computação social é usado para designar esse tipo de aplicação que tem como principais características facilitar ações coletivas e interações sociais *online*. Assim, esse aspecto da Web pode ser usado para prover um espaço virtual onde os designers possam interagir e obter informações de diferentes classes de potenciais usuários a fim de melhorar suas escolhas de quais elementos devem usar em seus projetos de interfaces.

1.1 Justificativa e Objetivo

Como resultado de um seminário promovido pela Sociedade Brasileira de Computação (SBC) em 2006, pesquisadores da comunidade acadêmica de Computação no Brasil elaboraram um documento descrevendo desafios para a Computação para os dez anos seguintes, no Brasil [Carvalho et al., 2006]. Dentre os desafios propostos, destaca-se o de número quatro que discute o "Acesso Participativo e Universal do Cidadão Brasileiro ao Conhecimento". De acordo com o documento, existem barreiras tecnológicas, educacionais, culturais, sociais e econômicas, que impedem o acesso e a interação do cidadão ao conhecimento disponibilizado por meio das novas Tecnologias de Informação e Comunicação (TIC).

O objetivo do desafio número quatro envolve, portanto, vencer essas barreiras por meio da concepção de sistemas, ferramentas, modelos, métodos, procedimentos e teorias capazes de endereçar, de forma competente, a questão do acesso do cidadão a esse conhecimento. Um dos caminhos apontados para atingirmos esse objetivo é "produzir tecnologia de base computacional que permita e motive a participação dos usuários no processo de produção de conhecimento e decisão sobre seu uso". O documento também sugere que: "(...) este acesso deve ser universal e participativo, na medida em que o cidadão não é um usuário passivo, o qual recebe informações, mas também participa da geração do conhecimento" [Baranauskas e Souza, 2006].

O conceito de DU [NCSU, 2008] ou design para todos foi proposto e vem se desenvolvendo ao longo das últimas décadas. Ele pode ser definido como uma abordagem ao design que visa produzir artefatos que possam ser usados pelo maior número de pessoas possível sem adaptação ou design especializado. Embora tenha sido proposto originalmente na área de arquitetura para projeto de casas e edifícios acessíveis a pessoas com limitações físicas como cegos e cadeirantes, esse conceito tem sido aplicado de forma geral no design

de TICs visando projetar artefatos tecnológicos acessíveis a todos, via suas interfaces de usuário.

Na medida em que os sistemas computacionais migram para a Web e tornam-se disponíveis a um número cada vez maior de pessoas, a importância de projetar interfaces acessíveis para todos também aumenta. Segundo a Pesquisa Nacional por Amostra de Domicílios (PNAD) realizada pelo Instituto Brasileiro de Geografia e Estatística (IBGE), o número de brasileiros com acesso a internet vem crescendo. Em 2005, primeiro ano em que essa pesquisa foi realizada, 32 milhões de brasileiros com mais de dez anos tinham acesso à Internet de uma população total de 152 milhões [IBGE, 2005]. Em 2011, último ano da PNAD disponível no site do IBGE, esse número passou para 77,6 milhões frente a uma população de 166,9 milhões [IBGE, 2011]. Dessa forma, no período de seis anos entre 2005 e 2011, o percentual de pessoas com mais de 10 anos com acesso a internet mais que dobrou, passando de aproximadamente 21% para cerca de 46,5%.

De acordo com o Comitê Gestor da Internet no Brasil (cgi.br) por meio do Núcleo de Informação e Coordenação do Ponto BR (nic.br), a proporção da população que é usuária de Internet passou de 24% em 2005 para 45% em 2010, considerando apenas a área urbana [NICBR, 2012]. As pesquisas apresentadas pelo nic.br em Agosto de 2012 [NICBR, 2012], apontam o custo elevado dos computadores como a principal barreira para sua aquisição, o que foi apontado por 74% dos domicílios. A falta de interesse e de habilidade também são motivos recorrentes aparecendo em 38% e 26% dos domicílios sem computador. Isto indica que a ampliação da posse do computador nos domicílios depende do acesso às TICs e do desenvolvimento de habilidades que podem ser obtidas por meio de uma maior alfabetização digital da população. Segundo Takahashi [Takahashi, 2000], alfabetização digital pode ser definida como a "aquisição de habilidades básicas para o uso de computadores e da Internet [...] em favor dos interesses e necessidades individuais e comunitários, com responsabilidade e senso de cidadania".

Assim, o objetivo deste trabalho é investigar e propor métodos, técnicas e sistemas que possam permitir e motivar a participação das pessoas no processo de design de interfaces, considerando a abordagem do design universal, possibilitando assim que qualquer pessoa possa contribuir com a interpretação e expressão de seu conhecimento sobre elementos que podem vir a constituir elementos de interface. Para isso foi proposto um modelo de sistema baseado em jogos com propósito, que potencialmente pode ser útil ao designer de sistemas para todos. Os jogos com propósito ou GWAPs do inglês *Games with a Purpose* são jogos que fazem uso da Computação Humana (do inglês, *Human Computation* - HC) para resolver problemas de difícil solução computacional.

1.2 Metodologia de Pesquisa

Tres grandes áreas do conhecimento servem de base teórico-metodológica a esta tese: Computação Humana, Computação Social e IHC.

Retomando o título da pesquisa, Jogos com Propósito e Construção de Conhecimento em Design, o conceito por trás dos jogos com propósito que adotamos, é o da Computação Humana. A Computação Humana é uma área recente de pesquisa em computação que, por meio de uma estratégia, faz uso da capacidade de processamento humano para resolver problemas de difícil solução computacional. A área de pesquisa em computação que trata da questão do comportamento social em sistemas computacionais, comportamento esse que, em últma instância, é o que promove a contrução do conhecimento em nossa sociedade atual, é chamada de Computação Social. Softwares com características sociais, pressupõem uma produção social colaborativa levando assim os usuários a participarem da sociedade do conhecimento. Já a área que trata do design e da interação das pessoas com sistemas computacionais, é a área de Interação Humano-Computador (IHC). A Figura 1.1 ilustra a relação dessas áreas com o título da tese.

Figura 1.1: Referencial Teórico

A Figura 1.2 ilustra em ordem cronológica como se deu o desenrolar da pesquisa. Nesta figura, os quadrados com fundo branco representam os passos da pesquisa enquanto os de fundo azul são os artigos produzidos ao longo do tempo. Como descrito anteriormente, esta pesquisa foi motivada em grande parte pelo desafio número quatro da SBC; após uma prospecção inicial buscou-se na literatura por recursos que pudessem colaborar com

a questão da participação do cidadão comum no processo de design de interfaces humano-computador. Encontrou-se então a área recém-criada da computação humana dentro da qual se inserem os Jogos com Propósito ou GWAPs. Montou-se então um experimento no contexto do projeto e-cidadania [Baranauskas et al., 2013] onde um protótipo funcional de um jogo com propósito foi avaliado por um grupo de pessoas representativo de diferentes camadas da população brasileira. O resultado desse experimento nos indicou a viabilidade de nossa proposta e gerou o artigo *GWIDO - Games With Iteraction design Objective* [Romani e Baranauskas, 2009] (Capítulo 3) publicado em 2009 na *IADIS International Conference WWW/Internet*, tendo recebido o prêmio de *Best Paper in the area of new research issues on the web* naquela conferência e sendo, em 2010, publicado uma versão estendida desse artigo na revista *IADIS International Journal on WWW/Internet* [Romani e Baranauskas, 2010].

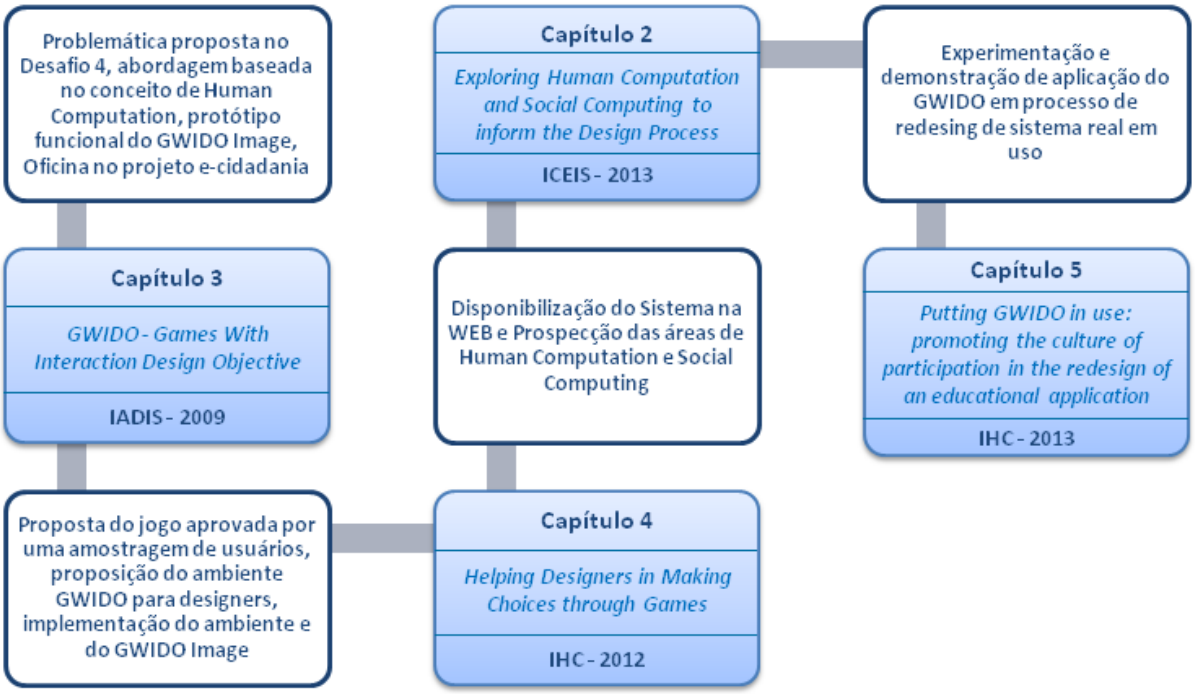

Figura 1.2: Organização da pesquisa

Nosso segundo passo foi então a implementação do jogo proposto e de um ambiente que ao mesmo tempo, fornecesse aos designers a possibilidade de disponibilizar conteúdo ligado a seus projetos de interfaces e aos cidadãos comuns a oportunidade de tomar parte no processo de design de interfaces por meio de jogos. O Ambiente

GWIDO foi apresentado no artigo *Helping Designers in Making Choices through Games* [Romani e Baranauskas, 2012] (Capítulo 4) publicado no *11th Brazilian Symposium on Human Factors in Computing Systems - IHC '12*.

Em paralelo, o acompanhamento da literatura levou-nos à necessidade de uma revisão bibliográfica extensa e atualizada que pudesse mostrar a originalidade da pesquisa. A revisão realizada nos gerou o artigo *Exploring Human Computation and Social Computing to inform the Design Process* [Romani e Baranauskas, 2013] (Capítulo 2) apresentado na *International Conference on Enterprise Information Systems - ICEIS 2013* que foi convidado a ser extendido e submetido à revista *Management Research News*. Finalmente, para a conclusão da pesquisa foi realizado e analisado o uso do Ambiente GWIDO por trinta e seis alunos divididos em doze grupos que utilizaram o GWIDO no redesign da interface de um sistema em uso na universidade. Os resultados foram publicados no artigo *Putting GWIDO in use: promoting the culture of participation in the redesign of an educational application* [Romani et al., 2013], apresentado no *12th Brazilian Symposium on Human Factors in Computing Systems - IHC '13*.

No decorrer do desenvolvimento do Ambiente GWIDO, houve um cuidado constante com a questão da acessibilidade; usamos o framework de desenvolvimento Dojo[1] que gera códigos em html e javascripts acessíveis, além disso usamos o software avaliador de acessibilidade DaSilva[2] para nos certificarmos de que o código gerado está dentro dos padrões de acessibilidade definidos pela W3C no WCAG2.0 [W3C, 2008] e pelo governo Brasileiro no E-PWG[3]. Mais detalhes técnicos são descritos no anexo B. Também foram executados testes piloto com colaboradores que permitiram avaliar a usabilidade do sistema, aperfeiçoar funcionalidades já implementadas e até acrescentar novas funcionalidades. Os testes piloto também possibilitaram avaliar e aperfeiçoar a escalabilidade (várias partidas rodando em paralelo), o caráter multiplataforma (com o uso de diferentes dispositivos e navegadores para acessar o sistema) e a confiabilidade (poucos erros ocorrendo em tempo de execução). Esses testes também permitiram que o Ambiente GWIDO fosse disponibilizado na WEB no endereço http://gwido.nied.unicamp.br/gwido. Parte desses testes está descrita no capítulo 4.

1.3 Organização da Tese

Esta tese está organizada em seis capítulos. Destes, os capítulos 2, 3, 4 e 5 são artigos publicados em conferências nacionais e internacionais que expressam a pesquisa realizada. O Anexo A apresenta detalhes técnicos do desenvolvimento e implementação da aplicação

[1]Dojo Toolkit, http://dojotoolkit.org/
[2]DaSilva, http://www.dasilva.org.br/
[3]E-PWG, http://www.governoeletronico.gov.br/acoes-e-projetos/padroes-brasil-e-gov

WEB desenvolvida no decorrer da pesquisa que engloba tanto o Ambiente GWIDO quanto o jogo GWIDO Image. Finalmente, o capítulo 6 apresenta a conclusão e os trabalhos futuros. A seguir é apresentada a descrição sucinta de cada artigo utilizado nos capítulos de 2 a 5:

- **Capítulo 2.** Exploring Human Computation and Social Computing to inform the Design Process. Romani, R. and Baranauskas, M.C.C. In: *Proceedings of International Conference on Enterprise Information Systems*. Angers, France: INSTICC Press, 2013. (ICEIS 2013), p. 44-51. ISBN 978-989-8565-61-7.

  - **Visão Geral e Contribuições.** Este capítulo apresenta a problematização da pesquisa e a situa com base em duas diferentes áreas de pesquisa, a *social computing* e a *human computation*. É apresentado o resultado de uma extensa revisão bibliográfica da intersecção dessas duas áreas por meio de um estudo dos GWAPs compilados em uma tabela contendo o nome e os autores do GWAP, seu propósito principal e quais habilidades humanas são usadas durante o jogo para atingir esse propósito. São identificados ainda quais GWAPs estão na intersecção entre as duas áreas de pesquisa por apresentarem características chave de ambas.

- **Capítulo 3.** GWIDO - Games With Interaction Design Objective. Romani, R. and Baranauskas, M.C.C. In: *Proceedings of IADIS International Conference WWW/Internet*. Lisboa, Portugal: IADIS, 2009. (WWW/Internet), p. 351-358. ISBN 978-972-8924-93-5. Disponível em: http://www.iadisportal.org/ digital-library/gwido-games-with-interaction-designobjective.

  - **Visão Geral e Contribuições.** Este capítulo discorre sobre os diferentes tipos de GWAPs e propõe um mecanismo de jogo baseado no modelo de concordância na saída, mostrando seu potencial para se obter informações do usuário final que possam auxiliar no design de interfaces para todos. O jogo proposto foi avaliado por um grupo de usuários especialmente selecionados de modo a compor uma amostra de diferentes camadas da população brasileira, com pessoas de diferentes faixas etárias, graus de instrução, classes sociais e graus de familiaridade com dispositivos eletrônicos. O artigo mediu a resposta emocional do usuário imediatamente após a experimentação com um protótipo funcional do jogo; os resultados mostraram a viabilidade da pesquisa quanto à aceitação por parte do usuário final do modelo de jogo proposto.

- **Capítulo 4.** Helping Designers in Making Choices through Games. Romani, R. and Baranauskas, M.C.C.In: *Proceedings of the 11th Brazilian Symposium on Human Factors in Computing Systems*. Porto Alegre, Brazil: Brazilian Computer

Society, 2012. (IHC '12), p. 229-238. ISBN 978-85-7669-262-1. Disponível em: http://dl.acm.org/citation.cfm?id=2393536.2393570

  - **Visão Geral e Contribuições.** Este capítulo apresenta o ambiente WEB já implementado, GWIDO, onde designers podem postar material de modo a ser usado no jogo com o objetivo de obter informações dos usuários sobre sua interpretação e associação de imagens a conceitos de interface. Tais informações podem auxiliar o designer na escolha de elementos gráficos de interface que são interpretados da mesma forma pelas diferentes classes de usuários. É apresentada ainda, uma avaliação preliminar realizada com intuito de avaliar a performance e robustez da implementação do sistema, a compatibilidade com diferentes dispositivos eletrônicos e navegadores e ainda uma avaliação heurística para melhorar a usabilidade do ambiente. Assim esse capítulo expõe como o ambiente pode promover a cultura da participação no processo de design de interfaces.

- **Capítulo 5.** Putting GWIDO in use: promoting the culture of participation in the redesign of an educational application. Romani, R., Gutiérrez, J. E. and Baranauskas, M.C.C. In: *Proceedings of the 12th Brazilian Symposium on Human Factors in Computing Systems*. Porto Alegre, Brazil, Brazil: Brazilian Computer Society, 2013. (IHC '13), p. 158-167. ISBN 978-85-7669-278-2.

  - **Visão Geral e Contribuições.** Este capítulo mostra um estudo de caso relativo ao uso do Ambiente GWIDO no processo de redesign de interfaces. O estudo foi realizado durante uma disciplina de IHC na Unicamp. Os alunos utilizaram o Ambiente GWIDO para obter respostas sobre escolhas possíveis de elementos gráficos ao fazerem o redesign de um sistema de apoio ao ensino presencial de graduação utilizado na universidade. O artigo faz uma análise detalhada do uso prático do Ambiente GWIDO mostrando como o ambiente pode ser utilizado pelos designers.

Chapter 2

Exploring Human Computation and Social Computing to inform the Design Process

2.1 Introduction

Since the HCI beginning, designers of interactive applications have been using several techniques to understand the users' tasks, their needs and potential new features that might improve the users' activities. Although these techniques are constantly being improved, the challenge has increased especially because of the development of new electronic mobile devices, the web evolution and consequent diversity of users.

When the scope of an application is well-defined and the set of potential users is limited and homogeneous, designers may use traditional HCI techniques to work the user interface elements representations in tune with the users' profile. However, the interaction design becomes more difficult as the number of user classes and systems requirements increase. In this context new support to the design process must be provided to capture this diversity.

The design for all [NCSU, 2008] approach proposes that systems should be projected for a huge variety of users with different conditions and needs. According to the HCI practice, the user is the most indicated stakeholder to validate the interfaces projected by designers, as well as to contribute during the design process. In several design projects it is difficult to involve a large and varied number of users through conventional user centered or participatory design methods. Thus, designers solve such difficulties adapting techniques and using their own experience. However, the web provides resources which can be used as an efficient mechanism of "unlimited" access to different users' classes worldwide.

This idea of using applications and services that facilitate collective action and online

social interaction is associated to the term "social computing". Several technologies such as blogs, wikis and online communities are examples of social computing. Although the scope of the term is broad, it includes humans in a social role where technology mediates the human communication. Thus, these aspects of the web could be used to provide a virtual space for designers to share experiences in order to propose design elements more suitable to users.

Although several standards, recommendations and guidelines are used to assist in the user interfaces development, much of the design still relies heavily on the designer's experience and knowledge. In other words, important decisions on specific parts of interface design such as choices about images, icons, sounds and other interface elements are complex tasks that could have the help of humans themselves to inform the designer's choices. For example, for a computer system, defining the best image among many to represent a concept such as "schedule meeting", is unthinkable. However, users can quickly choose which image is most representative for the concept. The paradigm that relates to the use of human endeavor to accomplish tasks that computers can not yet perform is defined as "Human Computation".

According [Quinn e Bederson, 2011] the difference between human computation and social computing is that social computing facilitates relatively natural human behavior that happens to be mediated by technology, whereas participation in a human computation is directed primarily by the human computation system. However, the same authors show that there is an intersection field between human computation and social computing.

This paper aims at shedding light on that intersection field by presenting possibilities of taking advantage of both fields to contribute to HCI research. In this scenario, this work proposes a new approach for supporting the choices of designers with users' contribution through enjoyable activities such as games. In addition, an environment where designers can socialize knowledge and information in the design process is suggested.

The work is organized as follows: Section 2 presents the background research fields, delineating the focus of interest of this paper; Section 3 organizes a preliminary literature overview in the intersection of human computation and social computing; Section 4 instantiates the idea proposed with the GWIDO environment; Section 5 concludes.

2.2 Background

Since the popularization of computational artefacts, people have worked with them in several interesting ways. More recently we have also engaged in communicating through computers. An alternative way to involve the human in a work process is using their processing power to solve problems that computers cannot yet solve. This is the modern usage of the term "human computation" as coined by [von Ahn, 2005]. He yet consid-

ers that it is feasible to solve large-scale computational problems and collect data to teach computers basic human talents. In fact, the idea is to put human brains working as processors in a distributed system, each one performing a small part of a massive computation [von Ahn, 2009]. Human computation is related to other terms such as collective intelligence, crowdsourcing, and social computing but they are not synonymous [Quinn e Bederson, 2011].

According [Howe, 2008] crowdsourcing is defined as the act of conducting traditional human work with ordinary people. An example is when a large group of people performs a job responding to an open call substituting a traditionally designated agent who would perform that specific job.

On the other hand, social computing is related to humans in social role where their communication is mediated by technology [Parameswaran e Whinston, 2007]. Blogs, facebook ©, twiter ©, wikis are some examples of technologies used to facilitate the collective action and social interaction online.

Computational problems which are solved by human computation are occasionally found in crowdsourcing and social computing applications. There is an intersection of crowdsourcing and human computation issues that is shown in Figure 2.1. Some applications can be classified in this intersection such as MonoTrans which provides a solution for the language translation task [Hu et al., 2011].

Collective intelligence is presented in Figure 2.1 as a superset of social computing, human computation and crowdsourcing. This term is defined by Malone et al. [Malone et al., 2009] as groups of individuals doing things collectively that seem intelligent. Some examples such as Wikipedia have shown a great number of people collaborating in the same project.

Although all research areas shown in Figure 2.1 are relevant and widely studied, this work focuses on the intersection of Human Computation and Social Computing. Principles of both areas can contribute to the interface design process since we can take advantage of the human ability to solve difficult problems, associated to the facilities of social networks. The different on-line social networks available on the web can enable the approximation of both users and designers of different regions and cultures.

With regard to Human Computation, a new set of systems have been developed since 2004 as casual games to collect annotations from human users; they are called GWAPs (Game With A Purpose). The GWAP concept was proposed by von Ahn [von Ahn, 2006] based on Human Computation principles. Problems solved by humans in GWAP games have two main assumptions: (1) computers alone are not good at solving them and (2) they are trivial for humans. ESP (the name is a joke with Extra Sensorial Perception) Game was the first GWAP proposed [von Ahn e Dabbish, 2004]. The ESP objective is to label images that are considered a complex task for computers. In this game, the

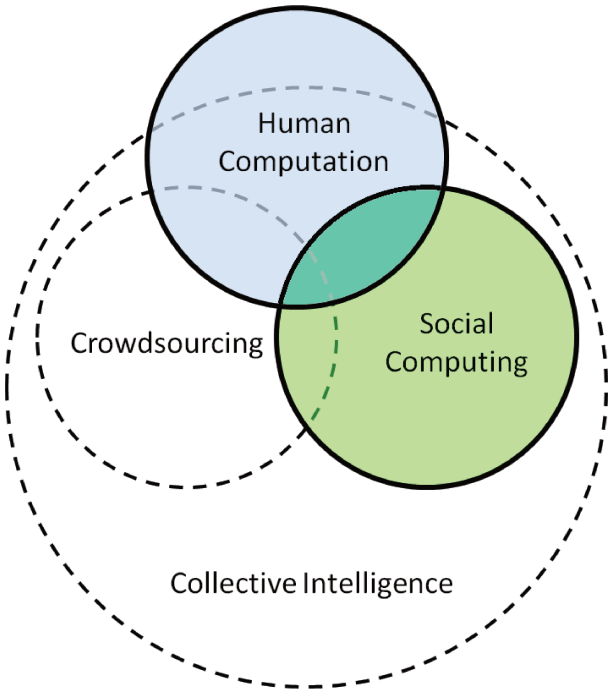

Figure 2.1: The intersection of Human Computation and Social Computing can be explored in benefit of interaction design process (adapted from Quinn e Bederson, 2011)

same image is presented to two players. Then, they should type words or phrases which describe the image. Each player does not know what the other one is typing, but if both type exactly the same thing, this word or phrase is a good suggestion for labeling that image. They will again receive a new image to continue playing. The players' goal is to label the largest number of images in a predefined time, getting points every time they coincide in the answers. GWAP is an example of collective intelligence since this type of game aggregate data from non-expert players helping in collective decisions that are similar to opinions from an expert [Chamberlain et al., 2012].

2.3 Human Computation and Social Computing: a preliminary survey

Several authors have explored different aspects of Human Computation and Social Computing in the last years [von Ahn, 2009, Parameswaran e Whinston, 2007, Quinn e Bederson, 2011, Wang et al., 2007]. With the objective of assessing the comprisement of both areas and their intersection, we conducted a survey on the number of articles published about each subject in digital

libraries of ACM and IEEE since 2004. A summary of results obtained in this search is shown in Figure 2.2.

The survey was conducted considering expressions such as: “Human Computation”, “Social Computing”, “GWAP”, “Social Games”, “Human Computation and Social Computing”, “GWAP and Social Computing” in order to evaluate each term separately and subsequently the association of two main concepts.

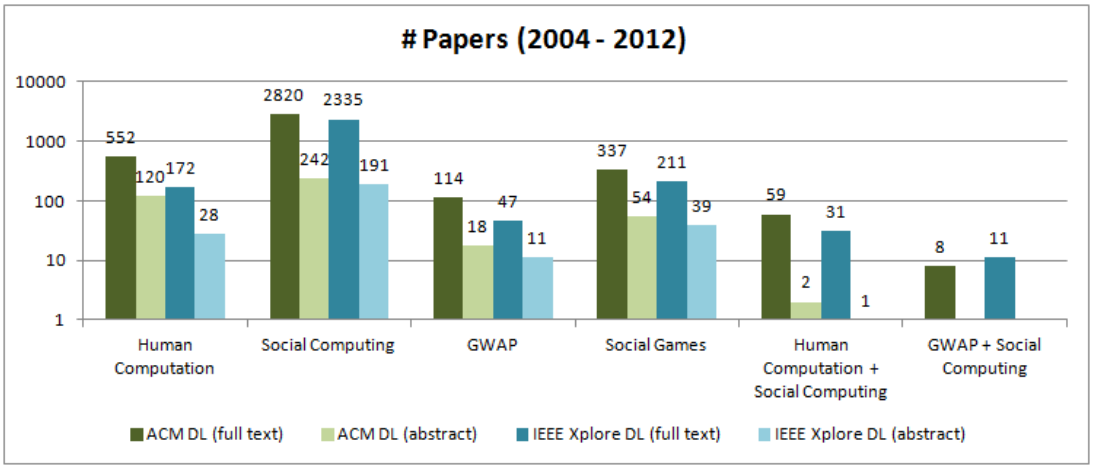

Figure 2.2: Number of papers published in conferences and journals.

Each expression was searched in the papers full texts and abstracts, in both ACM and IEEE digital libraries. The search was conducted in January 7, 2013, being restricted to articles published in journals or conferences from 2004 to 2012. This period was chosen considering the modern use of the term Human Computation that started from the proposition of the first GWAP called ESP Game published in 2004.

Results for the terms showed that the amount of articles about Social Computing is far superior to that one regarding Human Computation. In part, this result occurs because the Social Computing area has already being widely studied since 2004. Thus, to facilitate the display of results in the graph of Figure 2.2, we used logarithmic scale. Furthermore, absolute values were also plotted in the graph. GWAP and Social Games represent 22% and 10% of the research developed in Human Computation and Social Computing, respectively. Both terms are associated with the games area.

The intersection between Human Computation and Social Computing is still quite small since the search engine returned only ninety articles, all indexed by ACM and IEEE.

Moreover, when we search the terms GWAP and Social Computing together, few articles were found (nineteen). None of the retrieved articles addresses both terms on their abstracts. It suggests that these two issues have not been explored jointly.

Figure 2.3 shows a new representation of the survey results to present an accurate idea of the proportion of articles published in these fields. Thus we represent each field as a circle proportional to the number of articles found in the search.

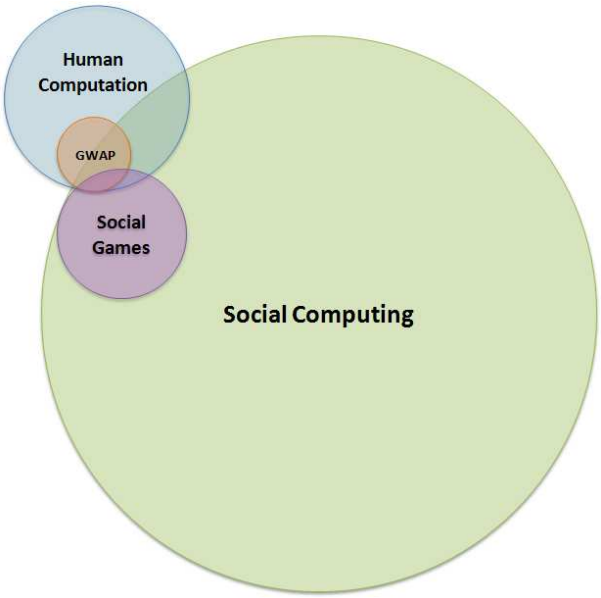

Figure 2.3: Schematic representation for the proportion of published articles and the intersection of fields.

A survey of GWAPs found in literature since 2004 considering the ESP game as the first proposed GWAP is presented in Table 2.1. GWAPs were grouped according to their main purposes.

We consider the support to interaction and content creation among communities of users as the main feature of a social computing application.

In this context GWAPs can be designed as a social computing application since the majority of them have support of interaction among people. In addition, by definition all GWAP produces information. However few GWAPs exploit the social potential for own benefit or for the benefit of the community involved. Information generated by GWAP usually brings benefits linked to their purpose such as image tagging.

Table 2.1 highlights those GWAPs, which explicitly promotes the communities' formation and generate information with some utility to these communities. These GWAPs can be classified as social computing applications such as Indagator, PhotoCity, SPLASH, Gopher Game, or they make use of information extracted from social networks where they are inserted as for example Phrase Detectives and GameMapping.

Main Purpose	GWAPs	Human Skill
(7) Image tagging	ESP Game [von Ahn e Dabbish, 2004]	Visual Recognition
	Phetch [von Ahn et al., 2007]	Visual Recognition and Writing
	KissKissBan [Ho et al., 2009]	Visual Recognition, Reading and Writing
	PexAce [Nagy, 2011]	Visual Recognition and Writing
	Karido [Steinmayr et al., 2011]	Visual Recognition
	ARTigo [Bry e Wieser, 2012]	Visual Recognition
	IdenticalEmotions [Aggarwal, 2012]	Visual Recognition and Feelings
(7) Location-based information	**Gopher Game [Casey et al., 2007]**	**Reading, Writing and Take Pictures**
	Eyespy [Bell et al., 2009]	Reading and Visual Recognition
	Indagator [Goh et al., 2010]	**Reading, Writing, Walking, Take Pictures**
	PhotoCity [Tuite et al., 2010, Tuite et al., 2011]	**Reading, Walking, Take Pictures**
	SPLASH [Goh et al., 2011]	**Reading, Writing and Visual Recognition**
	Tsai & Yang game [Tsai e Yang, 2011]	Reading, Writing and Take Pictures
	Glob [Kothandapani et al., 2012]	Reading, Writing and Visual Recognition
(4) Collect common sense facts	Verbosity [von Ahn et al., 2007]	Reading and Writing
	Rapport Game [Kuo et al., 2009]	Reading, Writing and Visual Recognition
	Virtual Pet Game [Kuo et al., 2009]	Reading, Writing and Visual Recognition
	Climate Quiz [Scharl et al., 2012]	**Reading and Writing**
(3) Create ranking/classifications	Matchin [Hacker e von Ahn, 2009]	Visual recognition
	Thumbs-Up [Dasdan et al., 2009]	Reading and interpretation
	Curator [Walsh e Golbeck, 2010]	Visual recognition
(3) Natural language processing	**OnToGalaxy [Krause et al., 2010]**	**Reading and Writing**
	Dil Cambazi [Gungor, 2012]	Reading
	Phrase Detectives [Chamberlain et al., 2012]	**Reading and Interpretation**
(3) Mapping users account across social network	**GameMapping [Shehab et al., 2012]**	**Reading**
	Pearl & Steyvers game [Pearl e Steyvers, 2010]	**Reading and Interpretation**
	GuessWho [Guy et al., 2011]	**Reading and Writing**
(3) Annotating videos	OntoTube [Siorpaes e Hepp, 2008]	Watching Videos and Interpretation
	Popvideo [von Ahn, 2008]	Watching Videos and Interpretation
	Waisda [Oomen et al., 2010]	**Watching Videos and Interpretation**
(3) Creating ontologies or relationships for semantic web	OntoPronto [Siorpaes e Hepp, 2008]	Reading and Interpretation
	SpotTheLink [Thaler et al., 2011]	Reading and Interpretation
	LittleSearchGame [Simko et al., 2011]	Reading and Writing
(2) Locates objects within images	Peekaboom [von Ahn et al., 2006b]	Visual Recognition
	P-HOG [Feng et al., 2012]	Visual Recognition
(2) Tagging music	Tag-a-Tune [Law e von Ahn, 2009]	Reading, Writing and Listening
	Herd It [Barrington et al., 2009]	**Reading, Writing and Listening**
(2) Generate streams of social annotation	**GiveALink Slider [Weng et al., 2011]**	**Reading, Writing and Interpretation**
	Great Minds Think Alike [Weng et al., 2011]	**Reading, Writing and Interpretation**
(1) Associate images with user action	**GWIDO Image [Romani e Baranauskas, 2009]**	**Visual Recognition and Interpretation**
(1) Visual research and surveys	Sketcharoo [Hebecker e Ebbert, 2010]	Visual Recognition, Writing and Drawing
(1) Labelling game characters	Shadow Shoppe [Islam et al., 2010]	Visual Recognition and Interpretation
(1) Image re-targeting for browsing images	RecognazePicture [Lux et al., 2010]	Visual Recognition
(1) Colect personal data	Bake Your Personality10 [Taktamysheva et al., 2011]	Reading
(1) Mining microblogs for advice-oriented information	**Twiage [Van Kleek et al., 2012]**	**Reading and Interpretation**

Table 2.1: GWAPS found in literature from 2004 to 2012

2.4 The GWIDO Environment

GWIDO Image is a game proposed in 2009 with the purpose of helping designers to make choices about interface graphic elements [Romani e Baranauskas, 2009, Romani e Baranauskas, 2010]. GWIDO Image is a collaborative and synchronous two player's GWAP that is played in the Web at http://gwido.nied.unicamp.br/gwido. GWIDO is an output agreement model game. Images and texts are its inputs provided by designers that represent possibilities of users' actions in Graphical User Interfaces (GUIs). This is one of the games within the GWIDO environment.

The GWIDO environment is a web social application where GWIDO games can be developed with different purposes by developers (Figure 2.4). Then these games can be played by any users on the web [Romani e Baranauskas, 2012].

Figure 2.4 illustrates a proposed architecture for the environment where several GWIDOs feed a common database. Through the GUI, designers register graphics or sound candidates and interface concepts associated to them into the GWIDO environment. These elements are used in GWIDO games. After some game rounds, the designer can collect results verifying the most representative images for different user profiles in the environment. Each designer accesses only the information of elements registered by him. In this model a researcher can make statistical analysis to verify, for example, whether there are regional or meaningful differences between the different user profiles, enabling a better informed choice of UI elements for the system.

All data collected during the game can be accessed by designers who included inputs to the game. These data can also be shared with the community of designers. Data gathered during the game roles are associated with the users' profiles to provide accurate information to help designers in making choices. For example, GWIDO Image presents inputs (text and candidate images provided by designers) and instructs the players to select the image that best represents this text. If both players select the same image, they get points. All choices are registered by the game and will be available on the environment for supporting the designer in his/her decision process regarding which image to use in his/her application.

The GWIDO environment is a social web application, located in the intersection of Human Computation and Social Computing. GWIDO incorporates the virtuous cycle of social computing in which the community uses a service offered by a computational system, providing information to this system that also uses this information to improve the service to offer to the community [Erickson, 2013]. This is a kind of relationship in which both sides win, what makes social computing such a productive field.

The GWIDO environment aids at creating this collaboration cycle between the en-

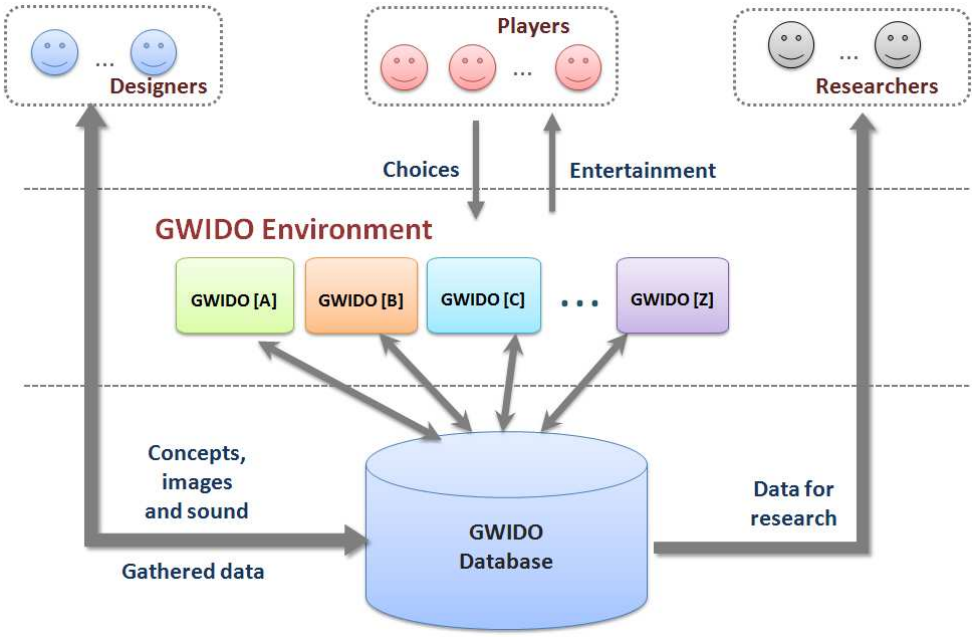

Figure 2.4: GWIDO environment architecture.

vironment and its users (designers in this case,); GWIDO also provides the possibility of making this cycle between designers and prospective users of the interfaces designed by them. In other words, when someone plays a GWIDO game, he/she is providing information to the designers to project new interfaces which can be used by these own players.

In this context, GWIDO is a socio-technical environment that may promote a culture of participation in the design of human computer interfaces.

2.5 Conclusion

When the scope of an application is well-defined and the set of potential users is limited and homogeneous, designers have been well instrumented in their practices. However, as the number of users increases augmenting their differences in profiles, the choices of designers become much more difficult. After a literature review on background work, this paper proposed an effort coming from the intersection of the human computation and social computing fields, as instrumental for supporting designers in their choices of user interface elements. Further work involves a large scale test of the proposed environment and practical case studies to available the effectiveness of this approach.

Chapter 3

GWIDO - Games With Interaction Design Objective

3.1 Introduction

While most games have the only purpose of entertaining [Crawford, 1984, Apperley, 2006], serious games [seriousgames.org, 2002], for example, are designed with the objectives of education and training, health, public policy, strategic communication, to name a few. Educational games and simulators for pilots training, for example, are classified as serious games.

The Web 2.0 has been characterized as a new generation of technologies for the construction of application interfaces that make possible the contribution of ordinary people in social networks mediated by Technology of Information and Communication (TIC). While the benefits of this new generation of Web technology are undeniable, without research and development actions that extend the access to people who do not have it even to the conventional Web, we may be excluding people from interaction.

The Web2.0 brought with it a new category of online game, in which groups of people collaborate in tasks for which algorithms are not effective such as tagging images [von Ahn e Dabbish, 2004], annotating content [Siorpaes e Hepp, 2008], locating objects in images [von Ahn et al., 2006b] and creating common sense databases [von Ahn et al., 2006a]. Games With a Purpose (GWAP) are described as combining "behavior, preferences, or ideas of a group of people to create novel insights" [Segaran, 2007, Rafelsberger e Scharl, 2009]. In this work we investigate the potential of this type of game in informing designers of user interfaces (UI) to better choices of images and other UI elements.

The graphic elements usually selected for the interfaces will have a direct impact on the interaction as they are interpreted by users as signs standing for specific tasks in a system.

Examples of these elements are the icons related with menu items or action buttons, which can take different representations. How should the representation associated to every item or button be in order to facilitate understanding by different users? The same difficulty occurs with audio elements in the interface. How is audio information interpreted by different users?

In general terms, the question we aim to address is how to maintain the promises of the Web 2.0 interactivity to the largest possible audiences? Answers to this question find challenges in its technical aspects of design as well as in its social implications. Interpretation of graphical and audio elements is very important not only for the semiliterate. From the point of view of the social implications of the accessibility in Web 2.0, additionally to the access of people with deficiencies, we have to consider the question of the population aging, that demands new forms of access and applications, and the treatment of the question of the digitally illiterate (illiterate in the use of computational technology), the majority of our population in Brazil.

Creating accessible features in the user interfaces within the Universal Design (UD) [NCSU, 2008] paradigm is a complex problem. Algorithms or solutions for automatic interface generation in this context are not feasible. This paper proposes a way of addressing the design of user interface elements within the design for all approach, through data collected from games based on the concept of GWAP. In this work, we adapted the concept of GWAPs to apply it to design problems. The paper is organized as follows: the next section presents GWAPs concepts, models and applications. Section 3 describes GWIDO: a new approach of GWAP within the universal design understanding. Section 4 shows a preliminary user test of GWIDO game in a context of a social network community. Finally, section 5 concludes the work.

3.2 Games With a Purpose

Von Ahn has proposed the first Game With a Purpose (GWAP): the *ESP Game* [von Ahn e Dabbish, 2004]. The intention behind this game is to label images, a complex task for computers. GWAPs is based into the human computation [von Ahn, 2007] concept which is an approach for using human processing power to solve problems that computers cannot yet solve. In this game, the same image is presented to two players. Then, they should enter words or phrases which describe the image. Each player does not know what the other one is typing, but if both type exactly the same thing, this word or phrase is a good indication for labeling that image. They will again receive a new image to continue playing. The players' goal is to label the largest number of images in a predefined time, getting points every time they coincide in the answers.

The *ESP Game* has been licensed by Google as Google Image Labeler and has been

used to generate a database of images labels. When users search an image in the Google site, he/she types a name or label. The Google search engine uses the labels database generated by the *ESP Game* to improve the search results. More than 200 thousand players have contributed with more than 50 million labels in the *ESP Game* [von Ahn e Dabbish, 2008]. In addition to this game, other games have been proposed, such as *Verbosity* [von Ahn et al., 2006a] and *Peekaboom* [von Ahn et al., 2006b]. Von Anh has proposed three models for the development of GWAPs that can be used as a basis to the creation of new games: output-agreement games, inversion-problem games and input-agreement games, briefly described as follows.

- **Output-agreement games**
  Initially, two players are randomly and anonymously selected. They receive the same input in each play, such as an image, sound etc. Their objective is to produce outputs to the input, such as sentences or words. The game instructions show that players must match their output. Players can not see or communicate with each other. They also can not see the output provided by their partners. Players must produce the same output, although not necessarily simultaneously, to score points in the game. This output has to be in the same round, while the input is displayed on the screen. There are no winners or losers in the play. Some aspects can motivate players, such as seeing their names in a ranking list. The game should be pleasant and agreeable to the player.

- **Inversion-problem games**
  As in the previous model, two players are initially selected randomly and anonymously. Players are alternated in the roles of "describer" and "guesser" in each round. The describer receives an input, for example, an image, phrase or word. The describer generates outputs based on this input which are sent to the guesser. The outputs from the describer are clues that help the guesser to reproduce the original input. If the guesser produces the output similar to the same original input presented by the describer, both mark points.

- **Input-agreement games**
  Two players are randomly and anonymously chosen, as in the previous models. In each round, each player receives an input which can be the same for both or not. The players are instructed to generate outputs based on their input. The outputs are visible to both. Each player, based on the outputs of the other, is able to assess whether his/her inputs are the same or different. They only mark points if both correctly determine whether they have been given the same or different inputs. GWAPs were developed to be played on the web. The Output-agreement

model was used in *ESP Game* to improve web-based image search. The Inversion-problem model was used in the *Peekaboom* GWAP to train and test computer vision algorithms [von Ahn, 2006] to collect a database of "common-sense facts" in the *Verbosity* game and in *Phetch* [von Ahn et al., 2006a, von Ahn et al., 2007] to provide image descriptions. The Input-agreement model was used to describe music in a GWAP called *tag a tune*. All existing GWAPs were designed using one of the three models described above.

3.2.1 GWAP Related Work

Recently, there had been much more progress in the area of human computation. GWAP concept may have had an important role in this evolution. However, there is still more potential for this category of computer games. Jain and Parkes [Jain e Parkes, 2009] have proposed a game-theoretic model to study play strategies in the ESP game. According to them, there are two different models namely *match-early* preferences and *rare-words-first* preferences.

GWAPs were developed to take advantage of web resources and the huge number of users in the Internet interested in activities of entertainment. Additionally, social networking had a great growth rate in the last years. Then, to benefit from these aspects, Rafelsberger and Scharl [Rafelsberger e Scharl, 2009] have proposed an application framework to develop interactive games with a purpose on a social networking platform. They have developed the "sentiment Quiz", a GWAP to evaluate whether sentences and dictionary terms express positive or negative sentiment. This game was proposed to Facebook users and their network of online friends.

Another example of GWAP application is games for users of mobile drivers. Matyas et al. [Matyas et al., 2008] has proposed "City Explorer" a location-based mobile game with the purpose to produce geospatial data which can be used into location-based service applications. Siorpaes and Hepp [Siorpaes e Hepp, 2008] have proposed to use games based in GWAPs to make players unknowingly build ontologies to increase user involvement in building the Semantic Web.

Phetch and *ESP Game* [von Ahn, 2006, von Ahn et al., 2007, von Ahn e Dabbish, 2004] provide image descriptions contributing to improve websites accessibility, according to the W3C Accessibility Guidelines [W3C, 2008]. These guidelines defines that all images have to show an associated textual description.

3.3 GWIDO - Games With Interaction Design Objective

The idea of GWIDO draws upon the concept of GWAPs with the specific objective of assisting designers in the UIs (User Interface) design. GWIDOs aim at helping designers to solve problems such as those exemplified previously. For example, a GWIDO based on output-agreement model could be used to solve the problem of selecting a graphical element for a specific menu item as reported previously. In this GWIDO model, the input is composed by a concept and an images dataset projected by the designer to represent that concept. The output is the image selected by the players to represent the concept. If there is output agreement, the two players get points. Thus, when the number of players is large enough, an image selected by many users can be considered a good candidate to represent the concept in the user interface.

The second example, also reported in the introduction section is similar to the first one; the only difference is in the type of the elements which are sounds instead of images.

A detailed proposal for a game to help designers in the choice of graphical elements using the concept of GWIDO with the output-agreement model is presented in the next subsection.

3.3.1 *GWIDO Image*: an example of GWIDO game

A new approach to implement the output-agreement model was proposed in order to create a game that helps to answer questions regarding which image best represents a concept. It involves reversing the logic of the *ESP Game*. We first present the concept and instruct the players to select the image that best represents this concept. For example, assuming that a designer wants to use an image to represent the action of "scheduling a medical appointment" in a governmental site for health service, the designer prepares candidate images to represent this concept and register them in the game. The Game will present the concept on audio or text formats and will display the candidate images or their audio descriptions. If both players select the same image, they get points in the game. Images associated to most coincident choices are considered good representations of that concept for the target users of the system under construction, supposing they are represented by the players.

Figure 3.1 illustrates two snapshots of *GWIDO Image*. One of them shows the concept 'scheduling a medical appointment' and candidate images to the player selection. Moreover, Figure 3.1 shows the current score and time of a play round, limited to one minute. An area for possible messages to players is located in the page bottom. A ranking is displayed in the final screen to make the player known within the player's community

and to show the player's performance.

Features such as timed response, score keeping, player skill level, high score lists, and randomness are game mechanisms that contribute to increase the players enjoyment [von Ahn e Dabbish, 2008].

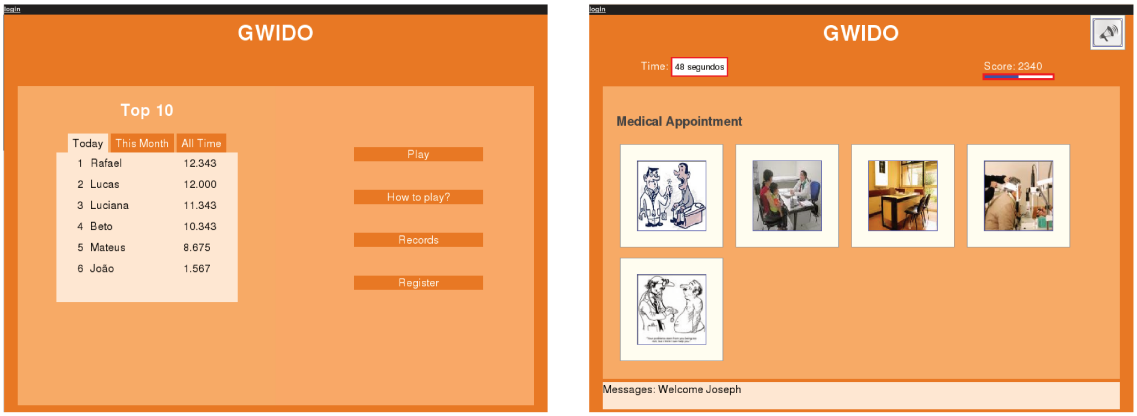

Figure 3.1: GWIDO Image game snapshots.

It is important to mention that one of the powerful ideas of GWAPs is directly associated to the scale factor, i.e. amount of users. In order to have a good reliability for the image representation related to a specific concept, it must have been selected several times by different players. Certainly there is no exact and predefined number to indicate that one image is representative of a specific concept for a target audience. However, between the candidate images, we can measure the number of times that the most chosen ones were relatively to the others. Then we can assess their relative degree of representativeness for such concept within the group of players.

Another possible scenario could occur when the choice of all five images are equally distributed as a result, i.e. there is no meaningful difference between them. This result could mean that all images have an acceptable representation or none of them correctly represents the concept for the players. The inclusion of the option "no image selected" in the game would help to differentiate these two situations.

GWIDO Image shows the number of users that selected each candidate image. Moreover it also offers information about the profile of the user who selected a specific image. This type of information is stored when players register themselves in the game. Thus, the designer will have information about the profile of users which can be used to help him/her in his/her decision making. Therefore, the designer has some data to assess how the graphic element he/she picks for the UI reaches each profile of the target audience.

This type of game, in which the concept is presented in text and candidate images are presented to players, is fundamental when considering the diversity of the target audience.

Considering the selection of UI elements for an e-Gov system in the Brazilian scenario, for example, this player population must include people with difficulties in reading. This problem is treated in the game by including the audio reproduction of the text related to the concept. This solution is aligned to the principles of UD or design for all, since blind people can also participate in the same game. This information is useful as the images must also be represented by their description as recommended by the W3C Accessibility Guidelines [W3C, 2008] for the graphic elements in web interfaces systems.

Other alternatives of implementation are feasible and would contribute to inform designers by storing the choices information on a database. For example, a game which keeps the same logic of the ESP Game, where only one image is displayed and players have to write what that image evokes. This game could present concept options, spoken by the game as they appear on the screen, to be selected by players. This game resource enables the use by low literate people in the target audience.

3.3.2 GWIDO games architecture

Figure 3.2 illustrates a proposed architecture where several GWIDOs feed a common database. The GUIs designers register graphics or sound candidates and interface concepts associated to them. These elements are used in GWIDOs. After some game rounds, the designer can collect results verifying the most representative images for different user profiles. Each designer accesses only the information on the elements he/she registered. In this model a researcher could make statistical analysis concerning, for example, if there are regional or meaningful differences between the different user profiles, enabling a better informed choice of UI elements by the designer.

3.4 Preliminary User Tests

Scalability on the number of players is an important requirement to create a game in the category of GWIDO. A working prototype of the game was developed for a preliminary test with potential users to assess the game acceptance and get the first impressions on it. Evaluation of candidate images is better when the number of players become larger and more diverse.

A methodological reference which allows evaluating aspects of affective-emotional quality caused by the system and its user interface was selected for this test. Technique, scenario, procedure and evaluation forms used in the test are described in detail as follows.

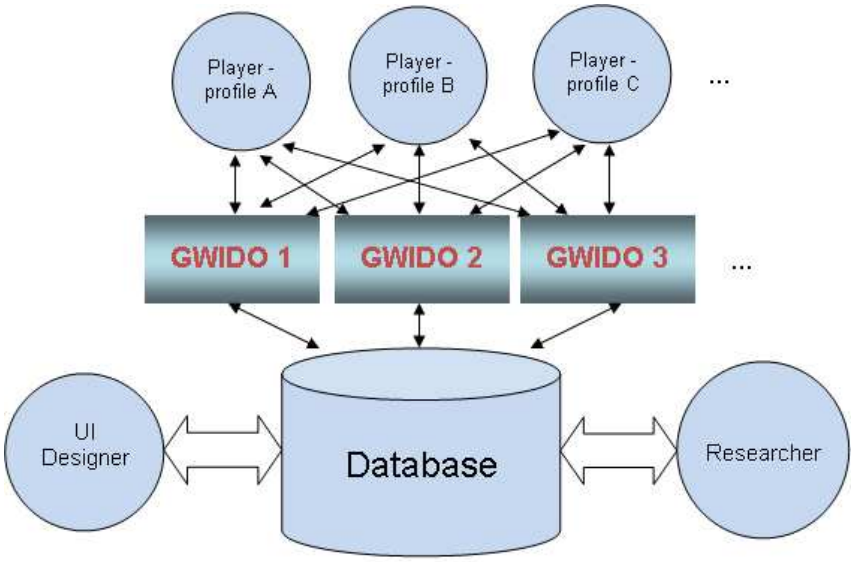

Figure 3.2: GWIDO games architecture.

3.4.1 Scenario and Methodology

A practice with users was conducted in a telecentre called *Casa Brasil* which is located in Campinas city, Brazil. The place chosen for conducting user tests is a center with infrastructure to assist in the process of digital inclusion in the city periphery. *Casa Brasil* has been a partner of *e-Cidadania* [e Cidadania, 2008] a project that investigates and proposes solutions to the challenges of interaction models and interface design for systems in the context of citizenship practice. *E-Cidadania* project has proposed a social network system called *Vila na Rede* to explore concepts that make sense and are accessible by the community around *Casa Brasil* telecentre. Thus, this telecentre is a real scenario where the diversity of potential users is important to inform UI design. Furthermore, the telecentre is probably one of the places where the GWIDO games will be used and will be continually evaluated as we intend to integrate it in the *Vila na Rede* inclusive social network system. The users group who participated in the tests is diversified in terms of age and educational levels. We selected 13 users to participate as players and 7 people from the research group worked as observers. The test session was recorded by camera, video camera and mp3.

The method used for the affective evaluation of the game was adapted from Chorianopoulos and Spinelli [Chorianopoulos e Spinellis, 2006] who proposed and discussed a user interface evaluation framework for interactive TV applications. This method measures user's emotional response after interaction with an artifact regardless of the type of artifact; thus it can be applied to interactive TV or video games as well.

Chorianopoulos and Spinelli used three classes of instruments in their framework with emphasis on the SAM, acronym of Self Assessment Manikin. This instrument has been used to record human responses to several stimuli in consumer and advertisement research. SAM is composed of three iconographic scales, which corresponds to three dimensions of the PAD model of affect (pleasure, arousal, dominance). Thus, users check below or between icons along a continuous nine-point scale to indicate their emotional status. The pleasure scale is ranged from a smiling, represented by a happy figure to a frowning, symbolized by a unhappy figure. For measuring arousal, SAM displays sleepy pictures, with closed eyes and pictures portraying excitement, with open eyes.. For dominance scale, SAM classifies elements from a very small figure representing a feeling of submission to a very large figure representing a powerful feeling. In this work, we use the SAM as an instrument to record the immediate feeling of people.

After a brief explanation of the game and its main objective to the subjects, the test process was conducted in three stages as follows:

1. Holding free - in this step, users played at least three rounds being observed by developers and observers

2. SAM and Questionnaire - after the initial experience, players were instructed by the observers to complete the SAM form and a questionnaire, both in an anonymous way

3. Talk about the game - users, observers and developers gathered together for a conversation about the experience of playing the game.

3.4.2 Test Results

For each feeling state in the SAM form, we counted votes in three categories: positive (+), negative (-) or zero (0), depending on the column marked as illustrated in Figure 3.3.

Twelve players completed the SAM form where votes in three classes are summarized in Table 3.1.

Classes / Votes	**Positive**	**Zero**	**Negative**
Pleasure	10	2	0
Arousal	7	3	2
Dominance	8	4	0

Table 3.1: Results from application of SAM instrument.

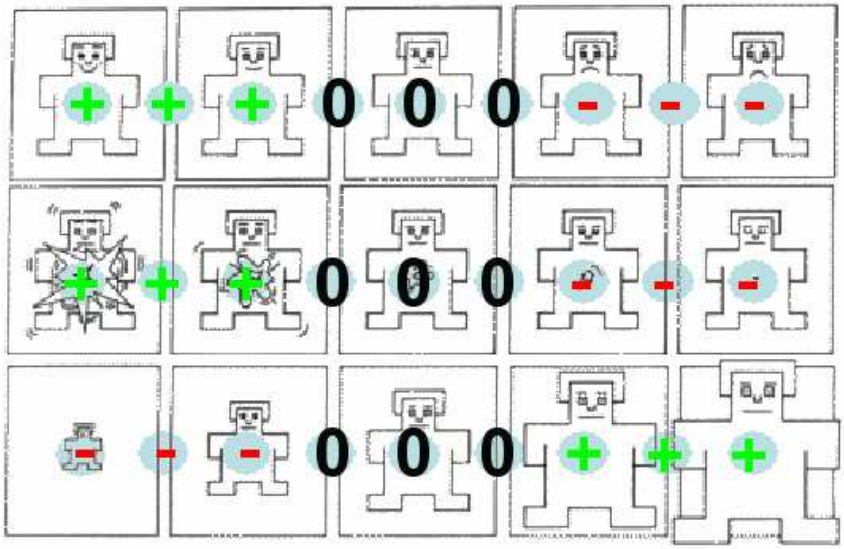

Figure 3.3: SAM form with 3 emotional states.

As can be seen from SAM method application, *GWIDO Image* was well evaluated in the 3 classes with more positive votes. Satisfaction and Control record no negative votes. Only the Motivation category received two negative votes of the 12 total.

Using the SAM instrument was very satisfactory in general. From a total of 36 votes 25 were positive, 9 votes were zero and 2 were negative. This result indicates that *GWIDO Image* had a good acceptance by the target audience. This acceptance was also observed during the stage of holding free and confirmed during the discussion.

The Questionnaire had five questions of multiple choice types. Three of them were related to player and two were associated to the game. Questions related to the player had the objective of collecting information about age, level of education and previous experience with gaming. The other questions regarding *GWIDO Image* were designed to record the players' opinion on the game itself and the round time.

Thirteen questionnaires were completely answered. Two persons did not answer questions related to the level of education and one of them did not answer the question about round time. Figure 3.4 shows two graphs which illustrate the data of players distributed by age and previous experience in playing games mentioned in questionnaires.

Not all people answered questions about their educational background. Among those who answered that question there were at least one of each profile. The first question was related to the duration of one *GWIDO Image* game round. Seven subjects stated that the duration of one game round was adequate, but five of them thought otherwise. None of them thought the duration of one game round was excessive.

Another question about *GWIDO Image* was proposed to evaluate the player´s feeling

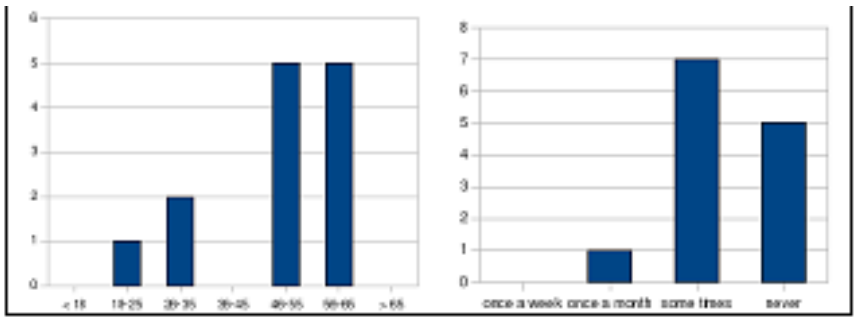

Figure 3.4: Players age and previous players experience.

at the end of the game. Thus we prepared some phrases which should be answered by users. Three persons noted the alternative "Cool, I want to continue playing" showing their enthusiasm. Nobody said that *GWIDO Image* was interesting but they do not like computer games. However, three players did not seem motivated about *GWIDO Image* as they marked the answer "boring, I did not like to play this game and I do not intend to play again".

3.4.3 Discussion

The questionnaire analysis showed that the users have low experience with electronic games. Nevertheless, most of them (10 out of 13) would like to continue playing or play again.

The motivation feeling was the only one of 3 factors measured by SAM instrument that received negative evaluations. In addition, only 3 players answered in the questionnaire saying that they did not like the *GWIDO Image*.

After answering the questionnaire and the SAM instrument, users were invited to attend a session of discussion about the experiment. During the discussion session, the players demonstrated their satisfaction with the experience of game use.

When we asked them if they would like to play the *GWIDO Image* on *Vila na Rede* site, they replied that would certainly play. Some suggestions for improving the game were made by users. Among them, a better visibility in the user interface to the text that describes the concept. Another suggestion made by players is related to the inclusion of a choice for not selecting an image. These suggested improvements should contribute to improve *GWIDO Image* and they will be incorporated in the game versions to be developed.

3.5 Conclusion

Games with a purpose have shown its usefulness in several situations. This paper presented a proposal of games based on GWAPs. The main idea is to help designers in their choices regarding UI elements within a Universal Design approach. The responsibility of the person who designs systems and Web interfaces, which should in fact be for everyone, should consider appropriate choices for elements of the user interface. We seek an alternative to assist in the design that could involve a large number of users in co-design of these elements. The proposal and the use of GWIDOs fit well in this regard adding the advantage of being fun to users.

The preliminary user tests showed the game acceptability for different user profiles. As the GWIDO database grows, it would be feasible to make statistical analysis of the behavior of different user profiles, identifying the existence of regionalisms and extracting patterns that could be useful for the design of electronic government systems, for example. Thus we hope that user interfaces can be designed to allow an increasing access to the part of population who has not had yet access to computer systems on the Internet and can effectively promote learning. Future works involve the development of new GWIDO games such as GWIDO audio to treat audio components in user interfaces with universal design approach.

Chapter 4

Helping Designers in Making Choices through Games

4.1 Introduction

Economic and technological developments in the world have allowed much more people to access computers. As a consequence, the design of user interfaces must accommodate different categories of users: from beginners to experts and/or from digital natives to digital illiterates.

Web 2.0 increases our capability of working collaboratively and asynchronously in a global scale contributing to the knowledge society construction. Nevertheless, there are still people who do not have access to the conventional resources of the web. Within the concept of access we include the underlying interaction model proposed by the application, which must be culturally meaningful to the user. Within this perspective, applications should embrace values, believes and habits of users in order to be easier for them to understand and interact in a more meaningful, sensitive and contextualized way.

It is well known that if users' cultural values are addressed in the design process model, their identification with the application, accessibility to the content and facility of use are increased, although addressing culture in the design process is still a challenge [Anacleto et al., 2010a, Anacleto e de Carvalho, 2008].

The concept of Universal Design (UD) [NCSU, 2008] or design for all has been developed over the last decades aiming at producing artifacts which can be used by as many people as possible [Choi et al., 2006]. Although this concept has originally been proposed in the architecture domain, UD has also been studied in the HCI domain to design user interfaces accessible for all [NCSU, 2008]. Designing interfaces for all within the Universal Design principles [NCSU, 2008] has been a challenge because the prospective design is supposed to attend different users' profiles, to the widest possible extent.

Approaches widely used by practitioners in the Human-Computer Interaction field have historically improved the design process, by bringing the human-being to the focus of design considerations (e.g. user centered design) and by increasing people´s direct influence on design choices (e.g. through participatory design), [Schuler e Namioka, 1993, Muller, 2003].

Participatory design methods have also been a way to consider the contexts of users with little or no access to information and communication technologies [Medhi, 2007, Hayashi e Baranauskas, 2008]. These methods have allowed the direct participation of users in creating solutions for design and development of interfaces in contexts of diversity. Although very effective in situating design solutions, the scenarios based on participatory design practices still face the challenge of scale.

Every designer faces the challenge of choosing images that are representative for their users, but when users can be anyone (UD), the challenge is even greater and there are no specific methods for this purpose that can help them. Thus it is still necessary to develop methods and techniques to make the design process as adequate as possible to the majority, including those still aside from the digital world. In fact, the design of interfaces in which people with different backgrounds, physical and socio-cultural conditions make sense of images, text and other elements of meaning present in the user interface (UI) of interactive systems has been an open challenge.

Thus, this paper proposes Web 2.0 services with massive participation of users asynchronously, based on GWAPs [von Ahn, 2007]. This approach offers the possibility of participation in the design process to an unlimited number of users, in a playful manner. The proposed environment takes advantage of resources offered by the web as well as in the interest of people for computer games in the web. The use of games to assist in the design process enables to investigate a new model of participatory design, exploring the human cognitive ability to solve problems that are complex to the computer at the same time that they enjoy playing. Thus, the designer can benefit from the contribution of a larger number of users with different profiles, which may help him/her in designing more inclusive interfaces. Such games will gather information about the interpretation users have for graphical elements proposed by designers. Based on that, designers might decide about which elements to use in their interface projects to reach the intended audience.

The paper is organized as follows: in the next Section we present related work and the GWAP concept. In the sequence, the GWIDO (Games With Interaction Design Objective) environment is presented. A GWIDO images game and results of its preliminary tests are shown and discussed, and finally we conclude the paper.

4.2 Background To The Work

Although there are newer online mechanisms such as remote usability testing [Hartson et al., 1996], distributed participatory design and open proposals [Rashid et al., 2009] or participatory design in context [Stevens et al., 2009], the design of universal and accessible interfaces is a difficult problem and its solution requires the involvement of diverse skills and domains [Bonacin et al., 2010, Baranauskas, 2009]. Therefore, there is a need to investigate new methods and techniques to help designers in enabling more open and flexible access to knowledge, considering people differences.

With the environment proposed in this work, designers (or HCI students in the role of designers), could experience and investigate their design solutions for all, based on the remote participation of anonymous people in the web, who would be playing a GWAP game. GWAPs are based on the human computation concept which involves using human processing power to solve problems that computers cannot yet solve [von Ahn, 2006]. The player usually does not have the intention of helping to solve the computational problem addressed by the GWAP; nevertheless, there is a purpose beyond the entertainment, on the part of the game itself. Different GWAP games have been developed for different purposes, such as ESP games to label images [von Ahn e Dabbish, 2004], the Peekaboom to train and test computer vision algorithms [von Ahn et al., 2006b], Verbosity [von Ahn et al., 2006a] to collect a database of "common-sense facts" and in Phetch [von Ahn et al., 2007], to provide image descriptions.

Serious games are defined as computer or video games that are intended to not only entertain users, but have additional purposes, such as government or corporate training, education, health, public policy, and strategic communication objectives. GWAPs can be considered a particular kind of serious games that uses the human computation ideas proposed by Luis Von Anh [von Ahn, 2007].

The basic difference between GWAPs and other serious games is the intention that leads people to play. In the first, people play just for fun while in an educational serious game, for example, people are aware of the intended learning process embedded in the game.

The ESP Game (the name is a joke with the initials for Extra Sensorial Perception) was the first proposed GWAP [von Ahn e Dabbish, 2004]. The ESP objective is to label images, considered a complex task for computers. In this game, a same image is presented to two players that do not know about each other. Then, they type words or phrases which describe the image. Each player does not know what the other one is typing, but if both type exactly the same thing, this word or phrase is taken as a good suggestion for labeling that image. They will again receive a new image and continue playing. The players' goal is to label the largest number of images in a predefined time, getting points every time

they coincide in the answers.

The ESP Game has been licensed by Google as Google Image Labeler and has been used to generate a database of image labels. When users search an image in the Google site, he/she types a name or label. The Google search engine uses the labels database generated by the ESP Game to improve the search results. More than 200 thousand players have contributed with more than 50 million labels in the ESP Game [von Ahn e Dabbish, 2008].

In addition to this game, other games have been proposed, such as Verbosity [von Ahn et al., 2006a] and Peekaboom [von Ahn et al., 2006b]. The purpose of Verbosity is collect common-sense facts. This game is played with two players in different roles. One of the players is the "Narrator" while the other is the "Guesser." The Narrator gets a secret word and must get the Guesser to type that word by sending hints to the Guesser. The hints take the form of sentence templates with blanks to be filled in. The Narrator can fill in the blanks with any word they wish except the secret word (or any string containing the secret word). By observing the Narrator's hints, Verbosiry can collect common-sense facts about the secret word. For instance, when the narrator says "It contains a keyboard" about the word "laptop," he learns that a laptop contains a keyboard.

The Peekaboom purpose is to train and test computer vision algorithms. For this game use, two randomly paired players assigned to the roles of "Peek" and "Boom." Peek starts with a blank screen while Boom sees an image and a related word. Peek's goal is to guess the associated word as Boom slowly reveals the image. Each time Boom clicks on the image, a circular area in a 20-pixel radius around that click appears to Peek, who can guess what the word is by typing it in a box below the image. When Peek correctly guesses the word, the players receive a certain number of points and then switch "booming" and "peeking" roles using a new image-word pair

These and other GWAPs have been proposed by Luis Von Anh and colleagues. Regarding the development of GWAPs, Von Anh has proposed three models that can be used as a basis to the creation of new games: output-agreement games, inversion-problem games and input-agreement games, briefly described as follows.

- **Output-agreement games**
  Initially, two players are randomly and anonymously selected. They receive the same input in each play, such as an image, sound etc. Their objective is to produce outputs to the input, such as sentences or words that describe the input. The game instructions show that players must match their output. Players cannot see or communicate with each other. They also can not see the output provided by their partners. Players must produce the same output, although not necessarily simultaneously, to score points in the game. This output has to be in the same round, while the input is displayed on the screen. There are no winners or losers in

the play. Some aspects that motivate players involve seeing their names in a ranking list. The game should be pleasant and agreeable to the player. The ESP game is an example of a GWAP in this category.

- **Inversion-problem games**
  As in the previous model, two players are initially selected randomly and anonymously. Players are alternated in the roles of "describer" and "guesser" in each round. The describer receives an input, for example, an image, phrase or word. The describer generates outputs based on this input which are sent to the guesser. The outputs from the describer are clues that help the guesser to reproduce the original input. If the guesser produces the output similar to the same original input presented by the describer, both mark points. The inversion-problem game model was used in gwaps like Verbosity and Phetch[von Ahn et al., 2007]. Verbosity was inspired in a popular party game called Taboo © [Hasbro, 2012], which requires players to say a list of common-sense facts about each word in order to get their teammates to guess it
  [von Ahn et al., 2006a].

- **Input-agreement games**
  Two players are randomly and anonymously chosen, as in the previous models. In each round, each player receives an input such as an image, sound etc. which can be the same for both or not. The players are instructed to generate outputs that are information based on their input. The outputs are visible to both. Each player, based on the outputs of the other, is able to assess whether his/her inputs are the same or different. They only mark points if both correctly determine whether they have been given the same or different inputs.

GWAPs were developed to be played in the Web. This means these games benefit of the diversity and scale in the Web to improve information access in the Web itself. The Output-agreement model was used in ESP Game to improve web-based image search. The Inversion-problem model was used in the Peekaboom GWAP to train and test computer vision algorithms [von Ahn et al., 2006b], in the Verbosity game to collect a database of "common-sense facts", and in Phetch [von Ahn et al., 2007, von Ahn e Dabbish, 2008], to provide image descriptions. The Input-agreement model was used to describe music in a GWAP called "tag a tune". All existing GWAPs were designed using one of the three models described above.

Other related games that can be cited here are those in the Open Mind Common Sense in Brazil Project (OMCS-Br). The project website aims at collecting cultural knowledge from people in order to provide cultural sensitiveness to computer applications, leading to

natural, flexible and useful interactive systems [Hornung et al., 2008]. Given a sentence or a media, people are stimulated to reflect on that and complete the given information. Some games derived from the OMCS-Br project such as "What is it?" [Anacleto et al., 2010b] are designed to support teaching transversal themes and also to collect cultural knowledge from certain communities in order to provide better understanding on human behavior related to environment, healthcare, gender, cultural diversity, and other themes.

The GWIDO Image, reported in this paper as an example of a GWAP in GWIDO environment, is a game in the output agreement model, where the input is a concept and a set of candidate images and the output is the most representative image for the concept, chosen by each player.

4.3 The Gwido Environment

4.3.1 Architecture

The GWIDO environment is a web application in which any person can play GWIDO games. Additionally, designers can upload images associated with an idea to obtain feedback from users about them.

During the design process, designers must decide about the best graphical element to represent an idea in the user interface. For example, when a designer wants to represent the idea of "posting a comment" he/she can propose a graphical element such as a person talking or a balloon with text inside or two persons talking, among other examples. The question is which image is most likely to be interpreted by most users as suggestive of the action of "posting a comment"?

In the proposed environment, GWIDO games use images uploaded by designers as candidate images to represent the concept or function. During a game run players choose the image that best represents the concept or function for them. After some game rounds, the designer can access the environment to verify which graphical elements were chosen by most users (players). The most voted image has the chance to be the best representative for the concept.

Figure 4.1 illustrates the proposed architecture for the environment where several GWIDOs feed a common database. Each designer accesses only the information of elements registered by him/herself. In this model researchers can do statistical analysis to verify, for example, whether there are regional or meaningful differences between the different user profiles, enabling a better informed choice of UI elements for the system.

In order to reach our purpose, GWIDO games should be designed to be played by anyone regardless of age, gender, education or experience with computers. Moreover these games should also be playable by blind, deaf and people with mobility limitations.

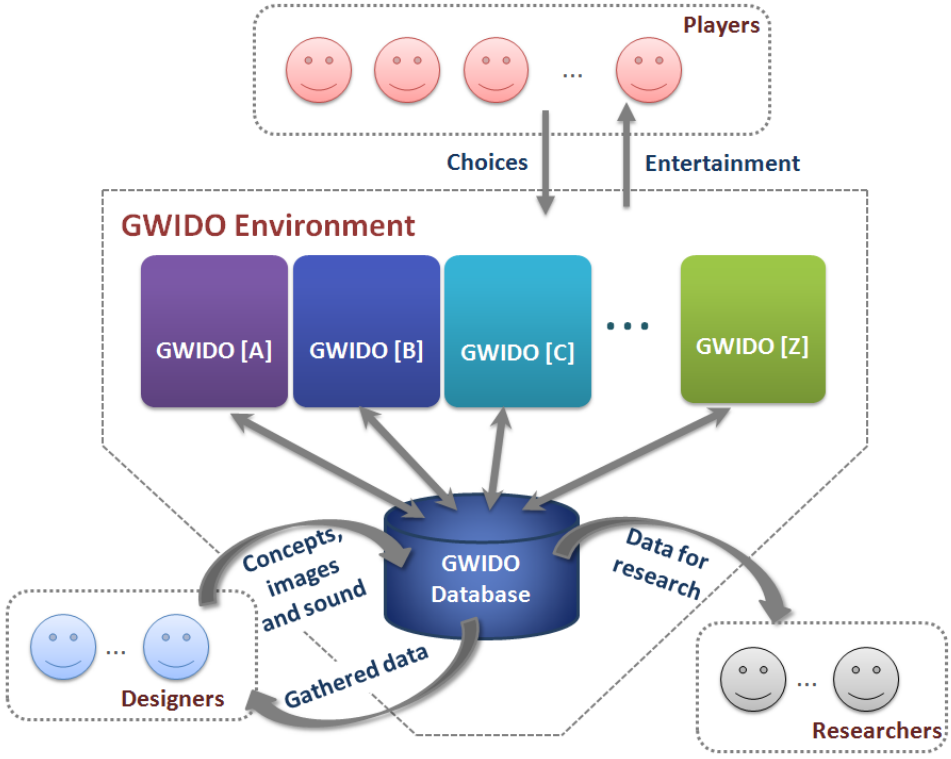

Figure 4.1: GWIDO environment architecture.

4.3.2 The Role of Player

People can access the GWIDO environment with three different roles: as a player, a designer or a researcher. In the role of player, during the registering process, a person is invited to answer about himself/herself providing some information regarding his/her age, educational level, social class and experience with web, before starting to play. This information is useful to identify which profile of user chooses each image. The player has access in the environment to play GWIDO games and to see his/her performance in the ranking of players.

The environment can provide different GWIDO games; this work reports the GWIDO Image, a game based on consistency in the output. In GWIDO Image, the entry consists of a sentence with the idea that a designer wants to represent in graphical form and a set of images projected by him/her to represent that idea; these images are named candidate images. The output is the image chosen by the players to represent the associated idea [Romani e Baranauskas, 2009].

GWIDO Image presents inputs (the sentence and candidate images) and instructs the players to select the image that best represents this text (output). If both players

select the same image, they get points. All choices are registered by the game and will be available on the environment for supporting the designer in his/her decision process regarding which image to use in the user interface.

Figure 4.2 is a sequence of screen shots general view that illustrates a sequence of interaction with the GWIDO Image game within the GWIDO environment. Figure 2a represents the initial screen of the game showing the ranking with the 10 best players in the left side of the screen. In the right side there are options to play, to see instructions and to register. "Home", "Enter" and "About" are menu options in the top. When the option "play" is selected a window is displayed for the user to log in or register if he/she is a new user (Figure 2b). After logged in, the GWIDO system seeks a partner to start a new game with the user, as Figure 2c illustrates. If no partner is found, the system simulates a human partner to play with the real human player. In order to simulate a player in a game, the GWIDO system selects and repeats the same sequence of concepts from a game played earlier using the same choices made by one of players, also keeping the time that player took to make the choice. Thus, in a simulated game only choices and points of the human player are computed.

In a game run, a sequence of concepts with candidate images is presented to a pair of players simultaneously. They are not aware of each other and must choose which image best represents each concept as illustrated in Figures 4.2d and 4.2e. If both players choose the same image both mark points and the game score is displayed at the top left of the screen. The remaining time of the round is displayed at the top right, being a minute and a half the total time for a game round. The play time must be short to not be bored for players in rounds where the one partner is much slower than the other. After each game run, players are asked whether they want to start a new game.

During a single play of the game, each of two players can choose up to 20 images for 20 different concepts that are presented. In other words, the number of concepts presented during each play of the game depends on how long it takes players to make their choices. Assuming that both players are fast they will get to choose about 20 images for different concepts in a minute and a half. On the other hand, if players are time consuming to make choices they can choose about 4 or 5 images for distinct concepts.

By the end of the game, GWIDO Image presents a summary (Figure 4.2f) where players can see the images chosen by them and their partner respectively. In this game there are no winners or losers, the goal is to stay on top of the ranking. The more a user plays, the better his/her chances of being well positioned in the ranking.

Features such as timed response, score keeping, player skill level, high score lists, and randomness are game mechanisms that contribute to increase the players enjoyment.

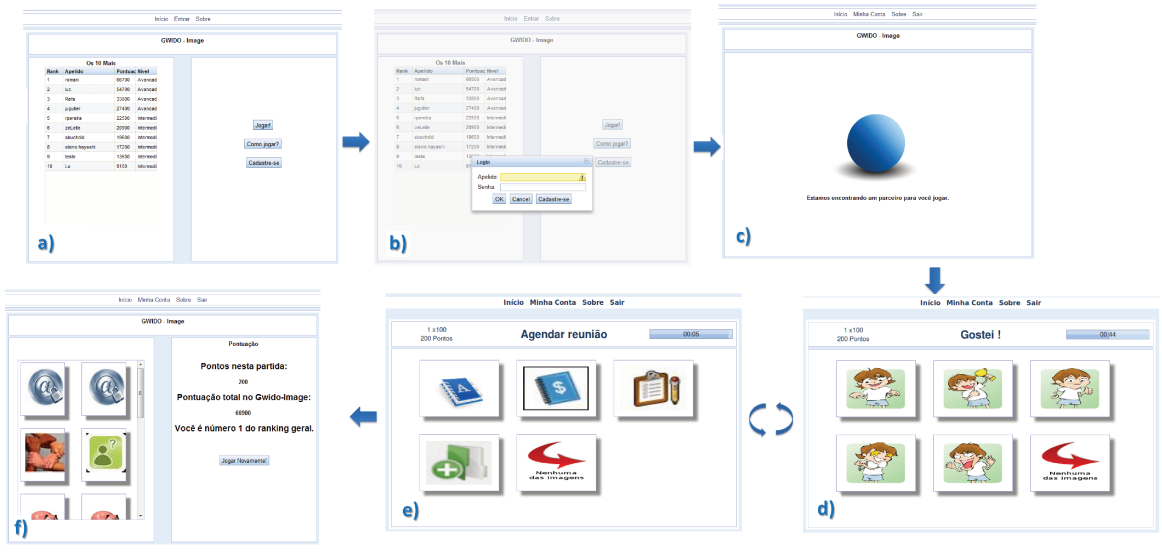

Figure 4.2: GWIDO Image game.

4.3.3 The Role of Designer

By registering in the role of a designer, in addition to playing games, the GWIDO environment also offers the functionality of entering concepts associated with graphical elements. The designer can choose among three different ways of registering interface elements in the environment:

- Private: only the owner has access to results regarding the element;
- Shared: people with whom the designer is related within the environment also have access to results of the element, and;
- Public: anyone registered in the environment can have access to the elements and results.

The GWIDO environment also offers the possibility of interaction and collaboration among designers. In this role people can create their profile that can be visited by other designers also registered in the environment. In addition, it can also provide useful information and recommendations about interface design such as links to legislation and standards of accessibility and usability. Designers can suggest links to websites and share their experiences with their peers.

Other designers may have registered elements for the same or similar concepts. In this case, the environment may suggest collaboration among them.

Figure 4.3 shows the environment screen shot where designers manage the concept ideas they want to investigate through the GWIDO games. There is no limit on the number of concepts to be entered into the system, but to ensure that all images are displayed on a single screen game, for each sentence they are allowed to upload the maximum of five candidate images.

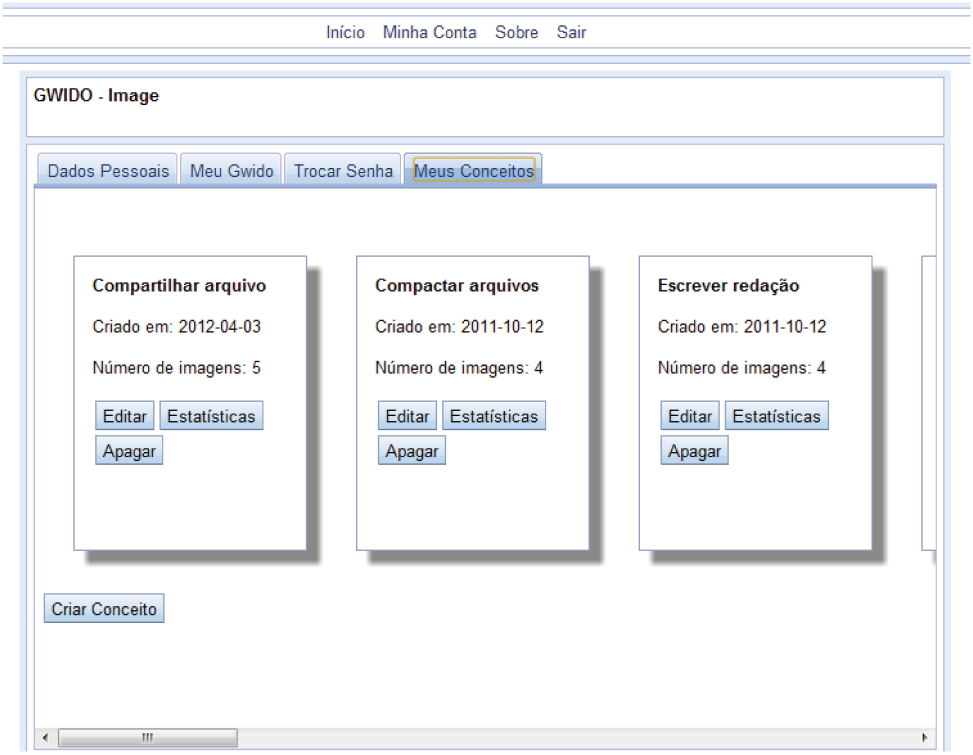

Figure 4.3: Concepts being registered by a designer.

By clicking on the button "Estatísticas" (Statistics) in Figure 4.3, the designer can access information about how elements of interface created by him/her were interpreted by different user profiles. Designers may also refine their proposals based on the interpretation of users. Therefore, the designer may assess how the graphic element he/she picks for the UI reaches each profile of the target audience.

Figure 4.4 shows an example of graphs generated by the GWIDO environment when a designer selected the option "Estatisticas". In this module he/she can see what the player choices related to one specific concept resulted after several game rounds. In Figure 4.4, the concept "Agendar reunião" was shown for 247 game rounds, having resulted in 10 skips and 48 matches. First the environment shows how many times each image was chosen and how many times the image resulted in matching of players, i.e., it was chosen simultaneously by two players.

Figure 4.4: Choices and matches feedback.

By clicking on details button ("Detalhes" in Figure 4.4), the system shows the distribution of choices regarding geographical location, educational level, social class, age of the players and experience with the web (see Figure 4.5). All this information is important to make decisions regarding the best choice, which depends on the target users intended by the designer.

When the designer positions the mouse cursor over a slice of any of the graphs of Figure 4.5 displays the system information relating to that slice. For example by placing the mouse cursor over the graph "Região Geográfica" (Geographic Region) with a single slice of 100% will display the information "Sudeste" (southeast).

4.4 The GWIDO Environment Preliminary Evaluation

A preliminary evaluation of the GWIDO Environment was conducted with the aim of assessing:

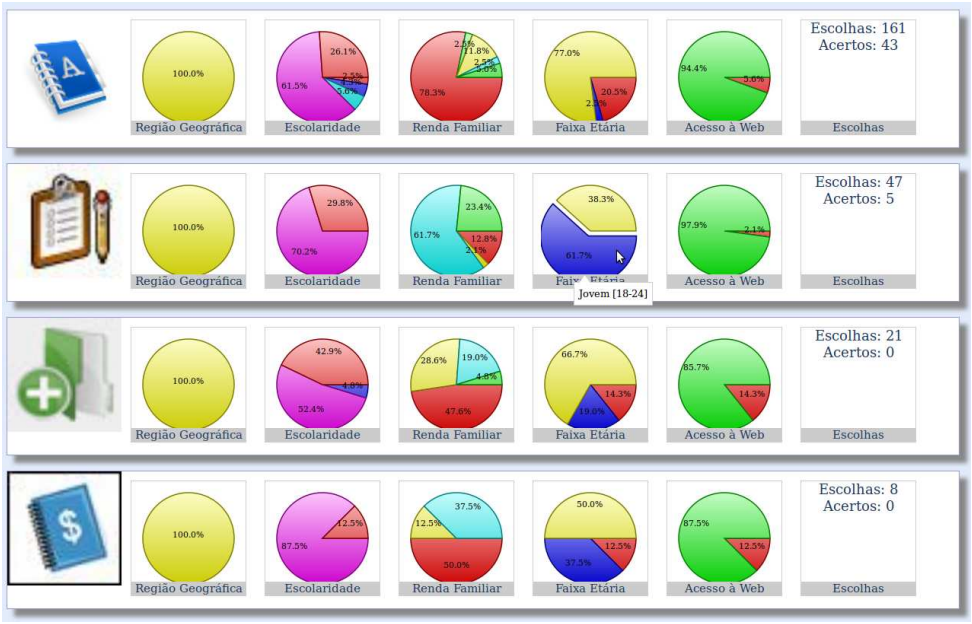

Figure 4.5: The choices distribution regarding geographical location, educational level, social class and age.

1. performance and robustness of the implemented system;

2. compatibility with different web browsers and

3. usability of the environment.

To reach these objectives we scheduled a remote test with sixteen subjects simultaneously accessing the environment in the web.

The group of participants was constituted by designers with graduate degree in HCI and other three ordinary people in the role of players. During the test, users were in different places accessing the environment from distinct network connections, and systems. Thirteen designers of different ages and both genre participated in this evaluation process of GWIDO.

The test was organized in three different steps:

Concept registration - First users registered in the GWIDO Environment as designers or as simple players' profiles. Then, some users registered as designers could register concepts and images associated to the concepts that would be randomly used in the second step of the test.

Game round - After registering, users were invited to start game rounds. The initial plan was to play during 10 minutes since a round lasts one and a half minute. The

main objective in this step was to assess different aspects of GWIDO, such as the performance and robustness to manage multiple rounds simultaneously, as well as usability issues.

Report - Finished the game round step, the users individually reported their perceptions and observations in a document. Moreover, they answered a questionnaire and included some suggestions.

Brainstorm and discussion - Some days later, the same group got together in a face-to-face meeting to have a whole picture of the test results and share their impressions regarding the 3 aspects under evaluation.

During the first two steps, participants communicated with each other and with the evaluation organizers through chats. Each one used different configurations of devices, operating systems, browsers and internet connections. Thus, the test scenario was very similar to a real situation of use. Table 4.1 shows different device configurations used in the test.

Device	**Used in the test**
Browser	Firefox 11.0, Firefox 9, Chromium 18, Chrome 18, Opera 11.62, Safari 5.1.5, Dolphin.
OS	Windows, Ubuntu, Kubuntu 11.10 64bit, MacOS, Android.
Connection	10Gb cable, 10Gb cable by wireless, 1Mb cable, 1Mb cable by wireless, wifi.
Hardware	Netbook, notebook, desktop, tablet, smartphone.

Table 4.1: Different device configurations used in the test.

4.4.1 Test Results

The time scheduled for the first phase of simultaneous game rounds was 10 minutes. However, after this time, the test participants continued playing new game rounds for about 40 minutes. This aspect can be considered an indication of the game´s enjoyability and its potential to hold the participants' attention. When asked why they wanted to keep playing, participants said they were having fun and were motivated to improve their ranking in the GWIDO Image.

A robustness problem was detected during the step two (game round) involving connections to the GWIDO's database. In fact, at the end of test, the GWIDO environment was not able to instantiate new games. This fact occurred because it exceeded the number

of connections to the database. This problem was caused because in some games database connections were not being correctly closed.

In terms of performance GWIDO environment did not present any delay or connection drop. Furthermore, the environment did not mix simultaneous games.

Reports produced by designers pointed out usability issues of the game user interface, especially screens related to the new user's registration as well as to the registration of concepts and images in the environment, since several HCI experts collaborate testing the environment. Some examples of usability issues that were pointed out by evaluators are as follows:

- when the message "waiting for another player" is being shown, we cannot know whether system is not answering or the other player is really slow to play;
- when the environment shows a new concept, the phrase below the images is being maintained, with respect to the previous concept;
- there is no exit/back option in the "My Account" screen. The user has to use the browser back option.

During step 3, participants pointed out thirty-four different usability issues that are summarized in Table 4.2 according Nielsen's heuristics [Nielsen e Molich, 1990].

All heuristic issues pointed out were valuable and the problems were already worked according to their severity ratings, resulting in a better conformance to usability standards.

#	**Issues Heuristics**
09	1 - Visibility of system status
03	2 - Match between system and the real world
03	3 - User control and freedom
06	4 - Consistency and standards
04	5 - Error prevention
03	6 - Recognition rather than recall
01	7 - Flexibility and efficiency of use
04	9 - Help users recognize, diagnose, and recover from errors
01	10- Help and documentation

Table 4.2: Number of issues by usability heuristics.

In addition to usability issues, during step three, participants also formalized suggestions for improvements in the system. These suggestions were discussed collectively during step 4 in the brainstorm. Among the key suggestions are:

- improve the function that select from data base a stored play game, when the player plays against the simulator;
- change randomly the order in which images are displayed in each round. (In one round, the images cannot be displayed in the same order on the screen for both players);
- implement a timeout of 20 seconds for the player to interact with the game. After 20 seconds the game finishes but the player is alerted that the game will finish in 5 seconds if he/she does not click on any image. After that, the other player is notified that his/her partner left the game;
- display how many people are online.

Strengths and weaknesses of each suggestion were discussed at the end of the brainstorm. Some suggestions were approved by presenting relevant strengths. Such suggestions have been implemented and incorporated into GWIDO. The issue of licenses of the posted images generated divergent opinions during the brainstorm. One member suggested that each designer should choose a license model for his/her images. The majority agreed that the system should set a standard license model for all designers.

4.5 Discussion

The goal of universal design or design for all is to achieve a user interface that is accessible to all users regardless of their age, experience, education, physical limitations or any other characteristic. In this sense, the GWIDO environment offers designers the opportunity to assess how the graphic elements of the interface are interpreted by users and displays detailed information about the users' profile that chose each type of image. Such information (Figures 4.4 and 4.5) subsidize the designer to choose the image that best suits the users, in the widest possible extension, as advocated by UD.

Each graph in Figure 4.5 shows the distribution of choices among different types of users per feature. For example, age feature is divided into four age groups; the most "universal" image regarding this feature would be the image that was chosen by players from the four age groups. The same reasoning applies for other features. Thus for an image to be considered "universal", it is not enough to have been chosen more, but it should have reached all users. Clearly, it is difficult to find the ideal image with a uniform distribution among all user profiles however the information provided certainly helps to identify which images are closer to the goal of design for all.

In addition, the environment can also be used to select images that best suit a particular audience; e.g. when designing interfaces to children or users with little experience

on the web, for example. Moreover, all the information collected is made available to designers.

Sometimes choosing the best image for a concept isn´t so easy; this occurs when two or more images are chosen by about the same number of players or when the more chosen image doesn´t have a good distribution. For example, assuming that the second image in Figure 4.5 have been chosen the same number of times as the first image, the designer would have to compare the graphics of geographic region, education, family income, age and rate of web access of the two images. In these cases the designer must consider which image was chosen by an audience as diverse as possible. Optionally, the designer can change the set of images and wait to collect more information to make his/her decision.

GWIDO environment doesn´t make decisions for designers; it just shows details about image choices to support the designer decision.

The environment test contributed to make the system more robust in terms of implementation, more useful from the standpoint of ease of use and most effective since there were suggestions for improvement of the system functionality as well during brainstorm.

As mentioned in the previous section, the fact that the players (designers who evaluated the system) did not stop as combined in the test is an indicator of the entertainment potential of the game. This aspect of the game GWIDO Image had already been positively assessed during the course of another experiment published in [Romani e Baranauskas, 2010].

Results of the environment test suggest that GWIDO, based on GWAPs, has potential to support designers in their decision processes regarding possible choices of UI elements. In fact, GWIDO is a novel way to explore the potential of the web, which is increasingly part of day-to-day lives, in favor of users and designers as well. It also promotes the use of games that can be played in quick starts in different devices in any environment at any time. Thus, this proposal is in line with trends in the use of computer systems for communication, entertainment and socialization. Therefore, the main contribution of this work was in instantiating the environment to help elucidate the perceptions of users, mainly those being digitally educated, for images representing concepts, ideas and/or functions in the web itself.

This approach differs from participatory design because of the lack of discussions characteristic of PD techniques. To bring this approach to PD we could introduce synchronous and asynchronous communication. As an example of asynchronous communication, GWIDO environment could provide a form prepared by the designer to obtain information and opinions from players. Synchronous communication can be made through embedding a chat in the environment. It is important to take the necessary precautions to prevent players from cheating the game by planning with other players through the chat, which image to choose, this could be done by preventing the user to simultaneously

participate in games and chat.

4.6 Conclusion

Certainly the task of creating usable, creative designs, exploring features of the Web2.0, and considering all audiences, including the digitally uneducated is very complex. To cope with difficulties and challenges faced by designers we proposed the GWIDO architecture that allows games to be developed to assist the designer in discovering which images would have a greater potential to reach larger scales in terms of number of users with or without needs and familiar or not with web browsing.

The proposal and the preliminary evaluation of GWIDO have shown a good opportunity for involving users in the design process with the advantage of being fun to them. The GWIDO Images presented is just one example of the type of game that can be developed within GWIDO´s platform. From the designer´s point of view, the variety of choices contrasted with the variety of user profiles provides a number of possibilities that can be studied. The database generated by the games gives designers a large amount of data that can be mined in searched for useful information for design. Moreover, the environment represents an opportunity for researchers as well (or designers in the role of researchers), to study cultural aspects associated to choices users make for the graphical representations of concepts and actions.

Chapter 5

Putting GWIDO in use: promoting the culture of participation in the redesign of an educational application

5.1 Introduction

The use of different technologies and digital artifacts has modified the nature of human computer interaction. Nowadays, technology is not only used in the work environment, it broke these limits to be part of everyday life of people in their home, social and cultural life. New artifacts are available through ubiquitous and mobile devices that reach all population. This moment of the human computer interaction represented by esthetics factors [Bertelsen, 2006], expansion of cognitive factors to emotional [Norman, 2004] and social-pragmatic aspects of experience [McCarthy e Wright, 2004] was defined by Harrison et al [Harrison et al., 2007] as the third paradigm of HCI. This scenario opposes to the context of work and rationality that are characteristic of previous paradigms for the discipline. The rigid guidelines, formal and systematic methods of the first paradigms are replaced or complemented by proactive techniques and qualitative approaches in order to study the situated use of technology [Baranauskas et al., 2008].

Although the demands of the third paradigm context are well recognized, it is still difficult to consider diversity among the users and to involve a great number of users in the design process. Thus, the main issue brought to light in this work is how to involve a massive number of users in the design process in order to grasp challenges of designing interfaces for all. We envisage two ways of dealing with the problem: social computing that includes collaborative production and web technology, which is able to broadcast and

collect information reaching a large number of users worldwide.

In the context of the third paradigm of HCI, applications classified as social computing have been emphasized. In general terms, social computing can be defined as the communication among humans in their social role, mediated by technology [Parameswaran e Whinston, 2007]. Moreover, the focus on work, from the previous paradigms, is amplified in the third paradigm since designers have to consider all aspects that involve users and their environment, not only their tasks. For example, a person accessing an application in the mobile device while he/she walks, and his/her emotional state may interfere in how he/she manipulates the application and interacts with others.

These social computing applications presuppose a collaborative social production, which allows users to migrate from an initial condition of passive consumers of products and information to active co-participants in the process of creating technology.

The culture of participation is not only dictated by technology but especially by changes in human behavior and in their social organizations. In this case, those who contribute actively are engaged in the design innovation, adopting and adapting technologies to their needs and wishes in a process of knowledge collaborative construction.

According Fischer (2011) "*a fundamental challenge for cultures of participation is to conceptualize, create, and evolve socio-technical environments that not only technically enable and support users' participation, but also successfully encourage it*". In addition, the culture of participation promotes opportunities to address problems in our societies such as problems of systemic nature that involve collaboration of many kinds.

On another point of view, an alternative way to involve many human minds in collaborative work processes is through the approach of Human Computation. This term was recently coined by von Ahn [von Ahn, 2005] who defined it as the use of human endeavor to accomplish tasks that computers can not yet perform. Some examples of this category of applications are ReCaptcha and GWAPs (Game With a Purpose) [von Ahn e Dabbish, 2008].

GWAPs have been developed for different purposes including tagging images, music and videos; collecting common sense facts; mapping users account across social network; among others. GWIDO (Game With Interaction Design Objective) is a socio-technical environment based on GWAP approach proposed to help designers in making choices regarding user interface elements [Romani e Baranauskas, 2012]. Thus, the GWIDO environment is a web-based social application where GWIDO games can be integrated.

The GWIDO environment promotes the culture of participation as it allows a collaboration cycle between the environment' users (designers) and prospective users of the interfaces designed by them. In this manner, the GWIDO environment can be classified as an application aligned to the third paradigm.

The aim of this work is to show the potential use of the GWIDO environment as a

mechanism of collaborative construction in the culture of participation perspective. The paper illustrates the use of GWIDO in a redesign problem, evidencing the benefits of massive involvement of users in redesigning interfaces.

The work is organized as follows: the section on background presents the related work, delineating the focus of interest of this paper; next section describes the use of the GWIDO environment in the redesign process; then we analyze this use and finally discuss results and conclude.

5.2 Background

The social computing area has been widely studied in the last years. A single search in the digital libraries indicates thousands of articles related to this field. Human computation is a recent area whose interest has increased since 2005 when von Ahn has published his PhD thesis. The number of articles about "human computation" is quite small when compared to the social computing contributions. Not many articles are found in the computer science literature relating these two work areas. GWAPs are in this intersection. Figure 5.1 illustrates the increasing in publications in these areas in the last five years.

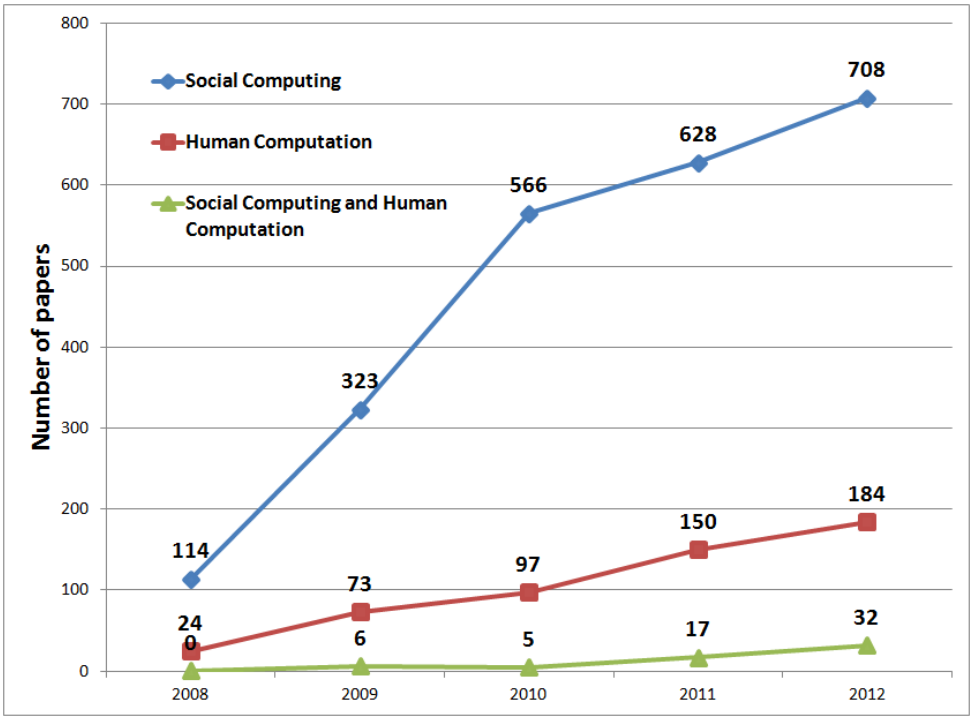

Figure 5.1: Numbers of articles published in the last five years.

GWAPs are games which explore the potential of human processing to solve problems

that computers cannot yet treat. There are many GWAPs with several purposes exploring different human skills. Table 5.1 presents a list of GWAPs that consider social aspects in the support to interaction and content creation among communities of users. They are grouped according to their main purposes.

Main Purpose	**GWAPs**	**Human Skill**
Location-based information	Gopher Game [Casey et al., 2007]	Reading, Writing and Taking Pictures
	Indagator [Goh et al., 2010]	Reading, Writing, Walking and Taking Pictures
	PhotoCity [Tuite et al., 2010, Tuite et al., 2011]	Reading, Walking, Taking Pictures
	SPLASH [Goh et al., 2011]	Reading, Writing and Visual Recognition
Collect common sense facts	Climate Quiz [Scharl et al., 2012]	Reading and Writing
Natural language processing	OnToGalaxy [Krause et al., 2010]	Reading and Writing
	Phrase Detectives [Chamberlain et al., 2012]	Reading and Interpretation
Mapping users account across social network	GameMapping [Shehab et al., 2012]	Reading
	Pearl & Steyvers game [Pearl e Steyvers, 2010]	Reading and Interpretation
	GuessWho [Guy et al., 2011]	Reading and Writing
Annotating videos	Waisda? [Oomen et al., 2010]	Watching Videos and Interpretation
Tagging music	Herd It [Barrington et al., 2009]	Reading, Writing and Listening
Generate streams of social annotation	GiveALink Slider [Weng et al., 2011]	Reading, Writing and Interpretation
	Great Minds Think Alike [Weng et al., 2011]	Reading, Writing and Interpretation
Associate images with user action	GWIDO Image [Romani e Baranauskas, 2009] [Romani e Baranauskas, 2012]	Visual Recognition and Interpretation
Mining microblogs for advice-oriented information	Twiage [Van Kleek et al., 2012]	Reading and Interpretation

Table 5.1: List of GWAPs which includes social aspects.

The four first GWAPs on the Table 5.1 were proposed with a purpose of dealing with location-based information. The first one is Gopher Game [Casey et al., 2007] which is a game based on agents representing tasks to be completed, the Gophers. As players move on their physical surroundings, they pick up gophers and help them complete their missions by supplying them with multimedia location-based content. By doing so, content sharing is achieved since other players may pick up these gophers and view the content associated with them. Another one is Indagator [Goh et al., 2010] which is a game that incorporates multiplayer, pervasive gaming elements into mobile content sharing. It allows users to annotate real world locations with multimedia content, and concurrently, provides opportunities for playing through creating and engaging in interactive games. PhotoCity [Tuite et al., 2010, Tuite et al., 2011] is a game played outdoors with a camera, in which players take photos to capture flags. It counts on collaboration of many people to create virtual 3D models of real buildings. The last one is SPLASH [Goh et al., 2011] that allows users to contribute and access location-based content. Layered upon this service, are gaming features that give users the opportunity to concurrently insert content through play. In SPLASH, information sharing features are interlaced with gaming features through virtual rooms where users interact, share information and play games. These rooms are designed to establish a sense of community among users to foster content sharing.

Climate Quiz [Scharl et al., 2012] is one example of GWAP for collecting common sense facts in the domain of climate change. It presents participants with two different strategies: to select the correct relation to connect two environmental concepts, and answer climate-related multiple choice questions. Climate Quiz aims at creating shared meaning through collaborative ontology building, a process that captures emergent semantics and elicits formal knowledge in the form of a domain model.

OnToGalaxy [Krause et al., 2010] and Phrase Detectives [Chamberlain et al., 2012] are examples of GWAPs for natural language processing. Phrase Detectives game enables groups of players to work on the same task over a period of time as this was likely to lead to a collectively intelligent decision. The game was integrated within the Facebook site to allow access to Facebook user data. It uses two styles of text annotation for players to complete a linguistic task. Initially text is presented in Annotation Mode. This is a straightforward annotation mode where the player makes an annotation decision about a highlighted section of text. If different players enter different interpretations for a same section of text then each interpretation is presented to more players in Validation Mode. The players in Validation Mode have to agree or disagree with the interpretation. OnToGalaxy have a different design from traditional GWAPs because it is a fast-paced, action-oriented science action game that provides a simple storyline and a progressive game-play. The human computation task is to find synonyms for german verbs.

GameMapping [Shehab et al., 2012] is an online social networking game; it is based on human verification and takes advantage of people's existing perceptual abilities. The game presents the player with a user from one social network, and a set of friends from another social network, which represent the set of mapping recommendations. The friends' information is summarized in a profile card. The player gets a small number of points for choosing one of the provided mappings, this reinforces a sense of incremental individual success in the game. The game also rewards social success by awarding the player a large number of bonus points when other users or friends agree with the player's provided mappings. Pearl and Steyvers [Pearl e Steyvers, 2010] proposed a GWAP for social information in text which create a database of messages annotated with social information. Unpaid participants provide knowledge about the social information in text. Participants are encouraged to generate messages that reflect specific social information and to label messages created by other participants as reflecting specific social information. Participants are given points for every message created that is correctly labeled by another participant, and for every message created by another participant that they correctly label. GuessWho proposed by Guy et al. [Guy et al., 2011], is another example of GWAP to map users account across social network. GuessWho is a crowdsourcing game for the enterprise, where users enter knowledge about their peers to enrich the organizational social network with additional relationships and tags.

With a purpose of annotating video, exploring the impact and success criteria of social tagging in the cultural heritage domain, Oomen et al. [Oomen et al., 2010] proposed the game Waisda?. This GWAP is a large-scale video labeling which use gaming as method to annotate television heritage, actively seek collaboration with communities connected to the content, and use curated vocabularies as a means to integrate tags with professional annotations.

Herd It [Barrington et al., 2009] is a competitive, online, multi-player game that has the implicit benefit of collecting tags for music. According to the authors this musical and social data can be used to build machine learning models that automatically associate music with tags. Herd It was designed to be social, running on the Facebook online social network and scoring is based on consensus between a large group of listeners - "the Herd".

Two social tagging games GiveALink Slider and Great Minds Think Alike were proposed to take advantage of human power to generate large streams of social tagging data [Weng et al., 2011]. These social annotations were utilized to help people organize Web resources and infer semantic relationship, which in turn can enhance Web applications such as search, recommendation, navigation, and categorization.

GWIDO is a GWAP with the purpose of helping in the interfaces design process. It is not only a game but also an environment [Romani e Baranauskas, 2012] where users can cooperate and interact with designers through games. Designers create concepts and upload images to be randomly used in the game. It captures the interpretation of different categories of users and shows this data to the designer in an organized way. Then the designer may take a decision about which images to use in an interface design or redesign process. Such mechanism enables the massive participation of users in the process.

Twiage is a game with the purpose of mining microblogs for advice-oriented information. The focus of Kleek et al. [Van Kleek et al., 2012] in Twiage was to determine how "raw" microblog streams could be turned into filtered and ranked collections using ratings from players. As in other GWAPs, this data could further be used in information retrieval contexts, or, as training data for machine learning/natural language classification approaches for predicting usefulness.

5.3 The Usage of GWIDO

The GWIDO environment as aforementioned helps designers in making choices aiming at promoting the design for all. In this sense, the environment offers a mechanism to consult a massive group of users regarding what could be the best choice for an element in the user interface being designed. An example of this functionality is the registration of concepts by designers that is illustrated in Figure 5.2.

GWIDO provides information to designers about how users interpret images; this

Figure 5.2: Screenshot of GWIDO environment showing registration of concepts.

data can be accessed in the Statistics module associated to each registered concept by the designer. An example of statistics related to representations for the concept "Favorite" can be seen in Figure 5.3.

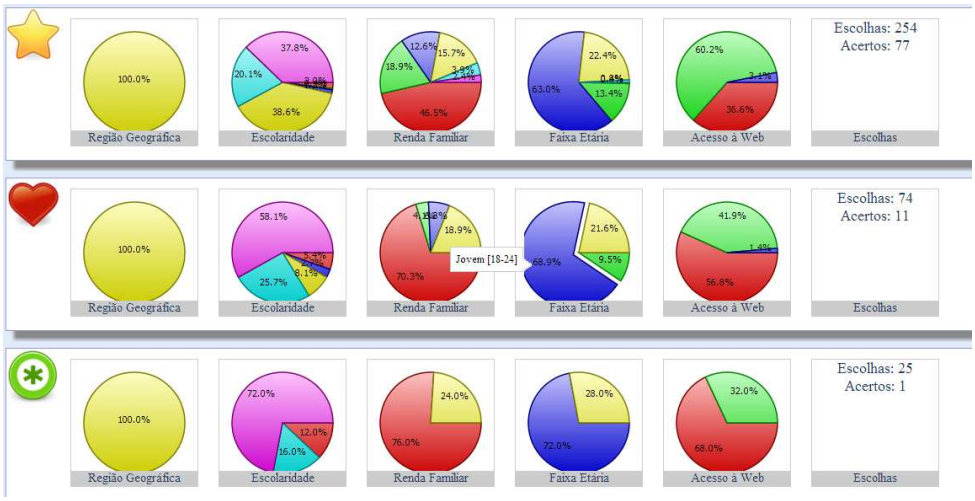

Figure 5.3: Statistics regarding images for the "Favorite" concept.

To evaluate GWIDO environment we proposed to students[1] of an HCI undergraduate discipline, the use of GWIDO in their task of redesigning a institutional web educational system in real use at the university. This discipline is taught in the sixth semester of Computer Science course. The classroom was composed of 52 students who were divided

[1]We tank all students that cooperate with this experiment.

in 13 groups of 4 students each.

The redesign proposed referred to a specific web interface of the e-learning system used in the university. This system is used by professors and students to complement content and practices of the traditional classes. The e-learning system was created in 2003 and since then its interface had never been updated. This e-learning system is integrated with the academic system of the university and offers to professors an instantiated area for each discipline on a Learning Management System (LMS).

Figure 5.4 shows one page of the original interface design for the web system. Similarly to the majority of systems in the last decade, the design of this system was based on text, menus and buttons. Altogether the original interface had six pages and a video tutorial.

Figure 5.4: Original interface of the e-learning system.

The redesign activity involved the inclusion of a new functionality to the system for which new interface elements were supposed to be created. This functionality allows users in professor's role to select one of two LMSs for each discipline.

During a live class, the activity of redesign proposal was presented to the students including the screens to be redesigned as well as the GWIDO environment to support them in the activity.

Students were familiar with the e-learning system interface since they are already users of this system, in the students' role. Although the screens to be redesigned were related to the professor's role, the user interface for the two roles is quite similar.

Even during live class, students began the redesign process in groups taking the opportunity to ask questions about the activity. At the end of that first class, students had an initial sketch on paper of their proposed redesign.

In a second class conducted in the laboratory, students continued the redesign process

having the opportunity to register images in the GWIDO environment.

Figure 5.5 is an images collection registered in the GWIDO environment by several groups of students to represent the concept of “Disciplinas”. These images were used in redesigns solutions by different groups.

Figure 5.5: Images collection representing the “Disciplinas” concept.

Students had a month to work on the interface redesign. Thereafter, all groups presented their redesign proposals in a live class.

Figures 5.6, 5.7 and 5.8 show some redesigns proposed by groups of students.

Figure 5.6 used large images registered in GWIDO to represent some concepts such as “Disciplinas”, “Professor”, “Video tutorial” and “FAQ”.

In the redesign proposed in Figure 5.7, the group of students used small images in the main menu itens: “Página Inicial”, “Disciplinas”, “Contato”, “Ajuda” and “Sair” as well as two images that indicate whether discipline had been set,(in green) or not (in red).

In Figure 5.8 designers (students) used images experimented in GWIDO to the option “Sair” in the banner on the top, to “Disciplinas”, to “Video Tutorial” and to “Documento de esclarecimento aos professores” in the left menu, to “FAQ” and to “Contato” in the foot of the page. In addition we can see in Figure 5.8 that there are three images to indicate whether a discipline is activated in each of both LMSs or if it was not yet activated.

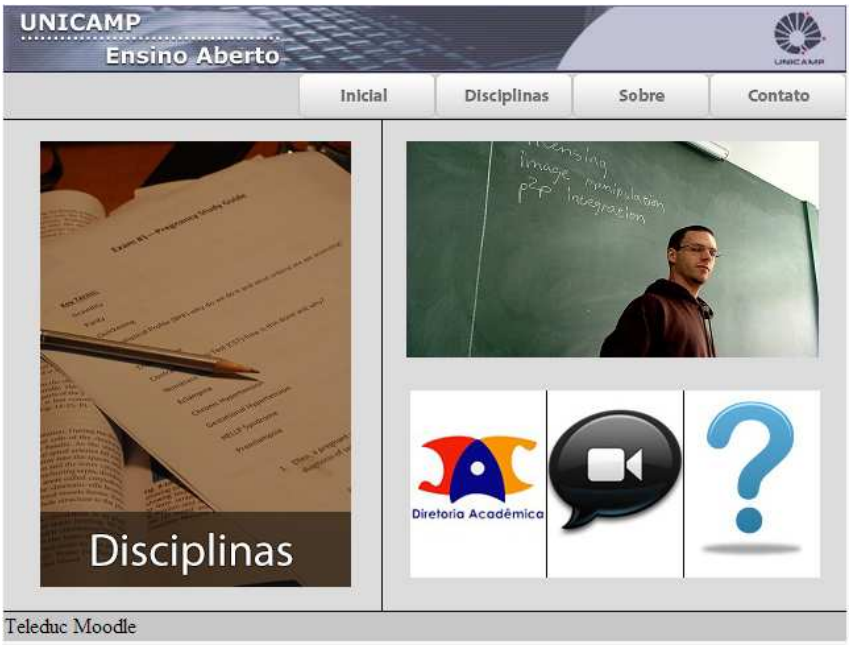

Figure 5.6: Example of proposed redesign using GWIDO i.

Altogether 69 concepts were registered by 13 groups including repetitions, for example, the concept “Disciplinas” was registered by nine groups. Grouping the repetitions, 26 different concepts were recorded. Table 5.2 shows how many groups registered each concept and how many images were registered for each concept as a whole.

During the period in which the images were available in the environment, they were used in the GWIDO Image game. The groups had three weeks to wait for information collected during the game. After that, the groups used the information collected to decide which images would be used in their redesigns.

Figure 5.9 illustrates how GWIDO informed about the data collected helping in decision making of one of the groups on their choice for the “Disciplinas” concept. In this example, GWIDO collected 42 choices. The image with more choices, was used in the redesign presented in Figure 5.6.

After final presentation accomplished by all groups, students were invited to respond to a questionnaire proposed to collect information about the experience of using GWIDO in the redesign process.

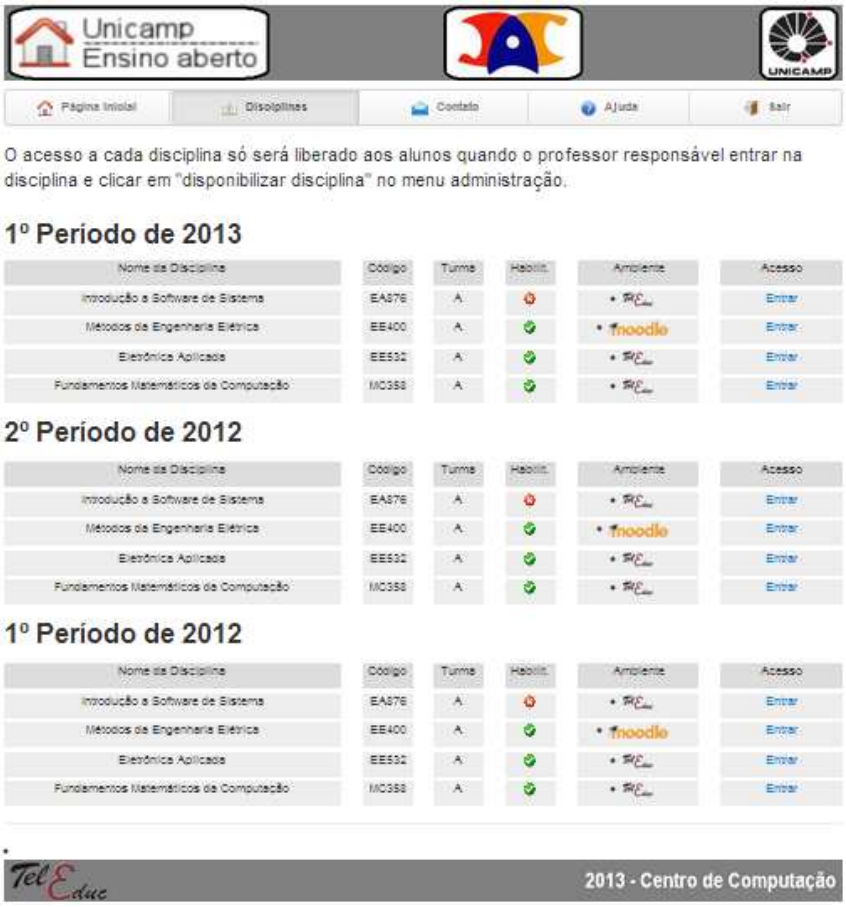

Figure 5.7: Example of proposed redesign using GWIDO ii.

5.4 Analysis of GWIDO Use in The Redesign Process

The data analyzed in this section were collected through a questionnaire which was answered by students as well as through analysis that have been made in the database of GWIDO environment. Seventeen questionnaires were answered. At least one student from each group answered the questionnaire.

Between March 14th and April 9th the site hosting the GWIDO environment received 824 visits, 7180 page views for 2192 unique page views. Once the images have started to be registered in GWIDO on March 14th, students were free to decide when the data collected in the GWIDO environment would be evaluated and used to support their decision of which image to use in their redesigns.

Some groups used the image that was selected more times during the matches of GWIDO. Other groups chose the second images more selected, because according to

Figure 5.8: Example of proposed redesign using GWIDO iii.

Concepts	# Groups	# Images
Agenda	1	3
Aluno	1	3
Ajuda	3	16
Avisos	2	8
Calendário	2	5
Como usar	1	2
Configurar	2	11
Contato	10	42
Curtir	1	4
Disciplinas	9	49
Dúvidas	1	4
Editar	2	8
Ementa	1	2
FAQ	5	16
Logout	1	6
Mais	1	2
Moodle	1	2
Notificações	1	3
Novos Emails	1	3
Página Inicial	7	31
Professor / Docente	2	6
Sair	5	15
Sobre	3	8
Teleduc	1	3
Trash (Deletar)	1	2
Vídeo tutorial	1	6

Table 5.2: Relationship of concepts, groups and images.

them, there was no significant difference between the first and the second images and they had a preference for the second image.

Concepts are used in the rounds of the game GWIDO image randomly. Thus, some

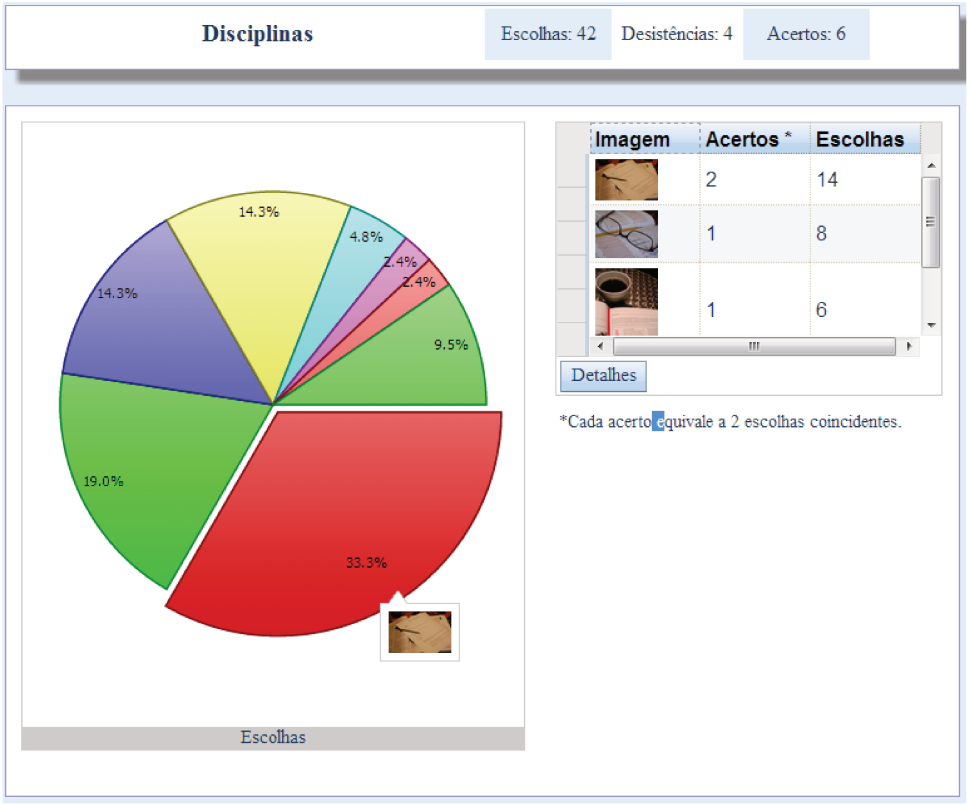

Figure 5.9: Results collected by GWIDO.

concepts may be used more than others. The most used concept collected one hundred and twenty-three (123) choices of gamers while the least one used obtained twenty (20) hits.

The number of access was also influenced by the time in which concepts were available in the GWIDO environment. The number of days varied depending on the time students had to insert the images and concepts in the environment, since the deadline for completing the redesign activity was April 09th.

Table 5.3 shows the number of concepts registered by each group and how many days they were available on GWIDO until conclusion of the redesign activity.

Students were asked whether the number of hits was sufficient for making the decision about which image to use. Eleven students (65%) considered the number enough while six students (35%) considered insufficient.

Students were asked about the optimal amount of choices (collected by GWIDO) they considered appropriate for their decision making in two situations: first if the image chosen by players coincide with the favorite image of the group; and second if the group´s favorite image does not coincide with the game result.

Groups	# Concepts	# Days on GWIDO
Group A	2	26
Group B	7	26
Group C	17	26
Group D	3	26
Group E	5	26
Group F	5	26
Group G	5	26
Group H	5	26
Group I	7	20
Group J	6	19
Group K	5	19
Group L	2	19

Table 5.3: Number of concepts per groups and time in GWIDO.

The favorite image represents the designer choice without considering GWIDO support. In both cases the possible options of responses were from:

- 10 to 20,
- 20 to 30,
- 30 to 40,
- 40 to 50,
- over 50,
- over 100 or
- other .

In the other option, the student should inform and explicate his response. The number of responses in both cases is summarized in Table 5.4.

The majority of responses was concentrated in “from 10 to 30” when the Designer preference image is coincident with first GWIDO image and from 30 to 50 when the images are different.

In the option other, students say that the optimal amount of choices depends on the percentage of choices that the first image received in relation to total choices.

5.5 Discussion

An important issue a designer faces is to decide which image to use for each concept representation in the user interface. Table 5.4 shows that when the image most chosen by

# of Choices	Coincident	Not coincident
From 10 to 20	6	1
From 20 to 30	4	1
From 30 to 40	1	7
From 40 to 50	2	3
Over 50	2	2
Over 100	0	2
Other	2	1

Table 5.4: Number of choices for decision making.

GWIDO image coincide with the choice that the designer would make without the use of GWIDO, most students (10/17) found that a number between 10 to 30 choices collected by GWIDO game is already enough for their decision making. On the other hand, when the image most chosen through GWIDO does not match the image that would be chosen by the designer, most students (10/17) said they would need a number between 30 and 50 choices to make their decision on which image to use at the interface (changing their initial choice). Ie, when the designer's opinion differs from the results indicated by GWIDO, designer waits more consistent GWIDO's response to make his decision.

The decision depends on several factors such as the experience of the designer and the type of audience that will use the interface. Thus, this process can be supported by GWIDO not only by the amount of choices but also the information about what category of users chose each image.

For six of the sixteen students who responded to the questionnaire, for all concepts recorded by his group, their favorite image coincided with the best positioned image by GWIDO. Only one student claimed that none of the concepts coincided with his own. Two students said they had not favorites but one of them said that despite having no favorites, he liked the images more accessed by GWIDO for all seven concepts registered by his group. For the other nine students, some concepts coincided.

The fact that there are many cases where the image preferred by the designer coincides with the image best classified by GWIDO indicates that the environment gets coherent answers by the players. In these situations the designer may feel more comfortable in making his decision. On the other hand, when the designer's opinion differs from the recommendation of the system, this can lead the designer to reflect on the choices.

5.6 Conclusion

Contemporary technology, available anywhere and to everyone brings challenges for the user interface designer, who does not have a homogeneous target audience anymore. This

paper presented and discussed results of using the GWIDO environment to inform choices of interface elements in a redesign of an educational application. We demonstrated the potential of the environment as a tool to support designers in their decision making regarding which are the best images to include in the system interfaces.

Results of the redesign process through GWIDO showed that this environment can promote the culture of participation contributing for HCI field with a new mechanism to allow user massive involvement in design solutions.

Capítulo 6

Conclusão e Trabalhos Futuros

Neste trabalho buscou-se uma solução para o problema de design de interfaces para todos que, ao mesmo tempo, permitisse e incentivasse a participação de um número virtualmente ilimitado de usuários como contribuintes no processo de design. Para isso, buscou-se na literatura, técnicas que pudessem promover a participação dos usuários no processo de design.

Dentre as alternativas encontradas estão os sistemas de Computação Social (SC) que possuem como característica a promoção da cultura de participação do usuário. Além disso, os jogos com propósito que fazem uso da Computação Humana (HC) para resolver problemas computacionais complexos ou de difícil solução mostraram-se como uma alternativa viável para incentivar a participação dos usuários em uma atividade que a princípio não faz parte do cotidiano dessas pessoas.

Desta forma, nesta tese é proposta uma abordagem que combina a Computação Humana e a Computação Social de forma a beneficiar-se de suas características para criar um ambiente no qual o designer possa conhecer as respostas de diversos usuários para opções de design, além de compartilhar conhecimento com os outros designers. Para validar a proposta, foi desenvolvido um sistema híbrido chamado GWIDO que combina características de ambas as áreas (HC e SC) de forma a melhorar o processo de design de interfaces para todos, com a participação de um número ilimitado de usuários que opinam sobre elementos de interface por meio de jogos com propósito. O jogo desenvolvido neste trabalho, GWIDO Image, demonstrou a viabilidade da proposta, além de contribuir com a construção de uma base de dados de imagens.

Assim, como nos sistemas de computação social, no ambiente GWIDO temos um ciclo virtuoso entre o sistema e a comunidade de usuários onde, para usar o sistema, a comunidade fornece informações que são usadas pelo sistema para melhorar o serviço oferecido pelo próprio ambiente GWIDO de volta a comunidade. Entretanto, o GWIDO também é um sistema de computação humana que usa uma atividade cotidiana das pessoas (jogos

online) para resolver problemas de design de interfaces para todos. Desse modo, conforme ilustrado na figura 6.1 o GWIDO, de uma forma original, cria um novo ciclo virtuoso onde a comunidade de pessoas no papel de designer de sistemas fornece informações ao sistema que as usa para oferecer jogos a uma comunidade de pessoas no papel de jogadores que, ao jogarem os jogos GWIDO, contribuem com os designers no desenvolvimento de sistemas que alcancem uma parcela cada vez maior e mais diversa da população integrando assim a comunidade de designers de sistemas computacionais à comunidade de usuários desses sistemas. Dessa forma o sistema potencialmente contribui para incluir cada vez mais cidadãos na sociedade do conhecimento e, por outro lado, o aumento de cidadãos incluídos beneficia o sistema que pode ser usado por um número cada vez maior de usuários gerando assim um novo ciclo virtuoso.

Figura 6.1: Os ciclos virtuosos do GWIDO

O conceito GWIDO (*Games With Interaction Design Objective*) foi apresentado e discutido ao longo desta tese. O método de uso desta nova proposta em design é detalhado nesta seção. O uso do GWIDO pressupõe que o designer precisa de ajuda para decidir quais elementos utilizar na interface de modo que ela possa ser interpretada adequadamente por uma variedade de usuários o mais extensa possível.

Como exemplo para ilustrar esse tipo de situação, considere-se um cenário onde o designer quer representar, por meio de uma imagem em sua interface, a funcionalidade de "marcar itens de uma coleção qualquer como favoritos". Qual a imagem que melhor representa a ideia de "favorito"? Uma estrela, coração, uma mão com sinal de positivo ou

o símbolo de positivo (adição)? Em nosso cenário hipotético esse seria um problema de design que poderia ser resolvido usando-se o modelo GWIDO representado na figura 6.2. Para resolver um problema como o descrito, o designer usaria o GWIDO Image; para isso ele cadastraria um conceito no Ambiente GWIDO que corresponde a inserir as imagens associadas à frase "marcar item como favorito"; em seguida, o designer teria que aguardar até que um número n de partidas fosse realizado utilizando o conceito em questão a fim de popular a base de dados com informações coletadas dos jogadores. Por fim o designer poderia analisar os dados para saber qual das imagens foi selecionada com mais frequência pelos usuários associando-a ao conceito. O número n de partidas varia dependendo da distribuição das escolhas entre as imagens de um dado conceito e em função da confiança do designer na escolha de determinadas imagens. Em uma situação onde a imagem mais selecionada possui uma diferença grande para a segunda imagem mais selecionada, por exemplo, 50%, n igual a 10 poderia ser suficiente. Já em uma situação onde a diferença entre as imagens é pequena digamos menor que 10% n igual a 10 seria insuficiente para o designer tomar uma decisão informada. Nesse caso é recomendável que se aguarde mais tempo até que uma das imagens se destaque em relação às demais. Entretanto, se n for muito grande (n maior que 100 por exemplo) e mesmo assim não houver uma diferença maior que 10% entre as duas primeiras imagens o designer poderia escolher aquela que possui a distribuição mais homogênea de escolhas entre os diferentes perfis de usuários. Caso a distribuição não seja homogênea em nenhuma das imagens, o designer poderia cadastrar e avaliar outro conjunto de imagens candidatas ao conceito.

Outro fator que ajuda a definir o número n é a própria opinião do designer. Em nossos testes, (conforme descrito no capítulo 5) ao serem questionados sobre qual seria o número ideal de escolhas a maioria dos designers respondeu entre dez e trinta escolhas no caso de ser a imagem preferida pelo designer ou entre trinta e cinquenta caso a primeira imagem não fosse a preferida por eles, o que equivale respectivamente a n entre cinco e quinze no primeiro caso e n entre quinze e vinte e cinco no segundo caso, uma vez que para cada partida são coletadas duas escolhas e n representa o número de partidas. Outro cenário possível para o ambiente GWIDO: considere-se um problema de design que não pudesse ser endereçado pelo jogo GWIDO Image; por exemplo, um problema que envolvesse a escolha de sons. Nesse caso o designer poderia propor um novo jogo do tipo GWIDO, conforme ilustrado no quadro a direita na figura 6.2. A criação de um novo jogo GWIDO no ambiente envolve os seguintes passos:

1. definir qual será a entrada do jogo;
2. criar um cadastro para o tipo de entrada definido;
3. definir qual dos três modelos de GWAP o jogo irá adotar: *input-agreement, output-agreement* ou *inversion-problem*;

4. implementar o jogo como um módulo do ambiente GWIDO;

5. adaptar o módulo de estatísticas para exibição dos dados coletados.

A entrada do jogo tipicamente deve ser constituída de um elemento de design e um texto ou expressão que corresponda à intenção que o designer pretende que aquele elemento comunique ao usuário. Ela precisa ser armazenada no banco de dados do Ambiente GWIDO para que possa ser usada no jogo; daí a necessidade de se criar uma tela de cadastro dessa entrada. Os três modelos de jogo são mecanismos para capturar a informação desejada do jogador. A escolha de qual modelo de GWAP adotar depende da entrada e da informação que se quer capturar. O GWIDO Image utiliza o *output-agreement*, os três modelos estão explicados nos capítulos 3 e 4. O ambiente GWIDO foi implementado de modo a permitir a inclusão de outros jogos. O jogo GWIDO Image pode ser usado como exemplo para a construção de um novo jogo GWIDO. Basicamente o Ambiente GWIDO oferece a infraestrutura para hospedar outros jogos. Os recursos oferecidos pelo ambiente estão resumidos no quadro a esquerda na figura 6.2. São eles:

- um mecanismo para sortear aleatoriamente dois jogadores que estejam on-line no ambiente a fim de se montar uma partida;

- uma base de dados onde o novo jogo poderá armazenar tanto as entradas quanto os resultados que correspondem aos dados coletados dos jogadores;

- o módulo de estatísticas que é usado para exibir os resultados coletados pode ser replicado e ajustado para atender adequadamente ao novo jogo;

- uma comunidade de designers e jogadores já cadastrados no ambiente;

- uma coleção de imagens já associadas a conceitos que podem ser eventualmente utilizadas para o novo jogo, caso necessário.

6.1 Principais Contribuições

Nesta tese, buscou-se atender ao desafio número quatro da SBC não só por meio da produção de tecnologia computacional que permita e motive a participação de usuários no processo de produção de conhecimento mas também no apoio aos designers de interfaces, provendo-lhes ferramentas que os auxiliem na criação e produção de interfaces que atingam parcelas cada vez maiores da população. Portanto, uma das principais contribuições é a proposta de uma nova abordagem para promover a participação massiva de pessoas no processo de design de interfaces apoiada nos conceitos de Computação Humana, por

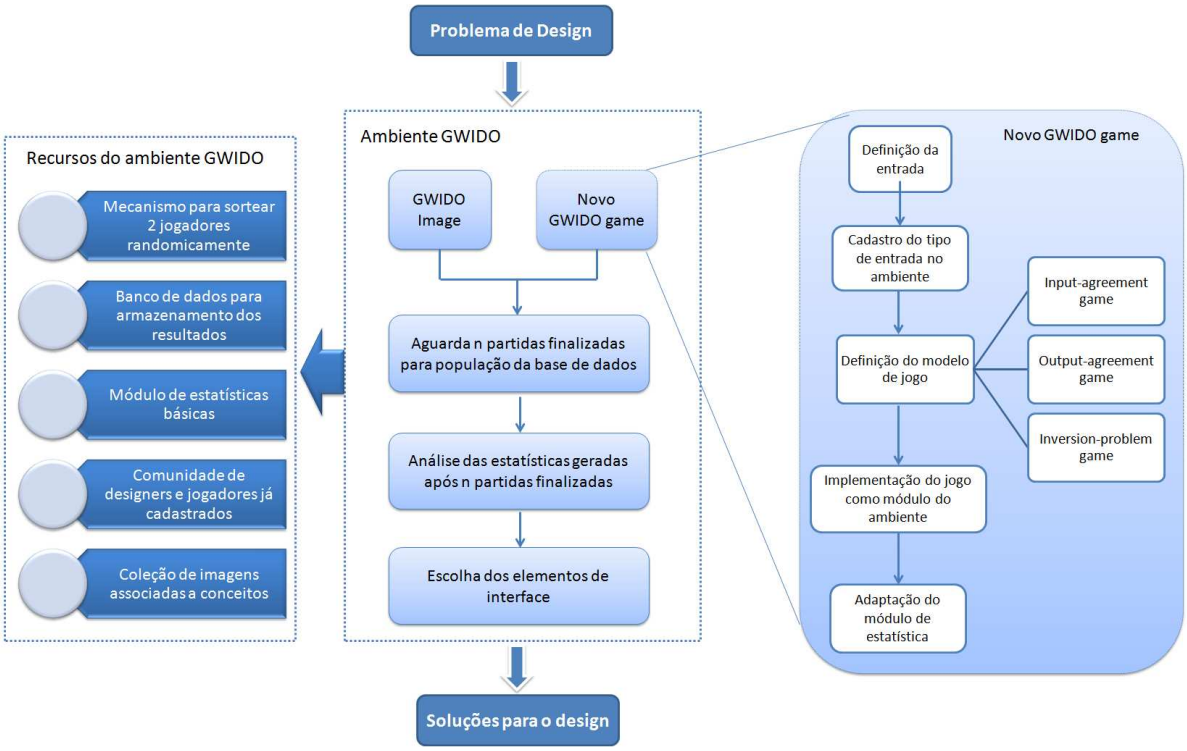

Figura 6.2: Visão geral do Modelo GWIDO

meio de Jogos com Propósito e de Computação Social. O modelo proposto, denominado GWIDO (*Games With Interaction Design Objectives*), apoia designers em suas escolhas de elementos de interface, bem como permite a colaboração/socialização de diferentes designers em um mesmo ambiente que se beneficia das características da Web 2.0.

Também é proposto um novo jogo com propósito (GWAP) denominado GWIDO Image, com o objetivo de auxiliar designers de interfaces na escolha das imagens mais representativas de conceitos e ideias a serem veiculadas nas interfaces sob o ponto de vista do design para todos.

Outra contribuição é uma plataforma web contendo a implementação do GWIDO Image integrado a um ambiente onde qualquer pessoa pode assumir tanto o papel de designer, incluindo conceitos e imagens no jogo, quanto de jogador, colaborando no processo de design de interfaces de maneira lúdica.

De forma complementar, este trabalho também contribui com um estudo bibliográfico abrangente dos GWAPs desde sua proposição em 2004 até 2012, organizando-os por propósito e identificando quais habilidades humanas são exploradas em cada um deles. Além disso, também identifica quais GWAPs possuem componentes sociais podendo assim ser posicionados na interseção entre Computação Humana e Computação Social.

Outras contribuições deste trabalho são listadas a seguir:

- ambiente GWIDO implementado e disponível permitindo o desenvolvimento e inclusão de novos jogos com propósito de apoio a designers no processo de design de interfaces;

- jogo GWIDO Image disponível na web para uso por designers com dezenas de conceitos cadastrados;

- banco de conceitos e imagens disponível para uso podendo ser minerado em busca de padrões e informações úteis ao design;

- módulo de análise estatística das preferências de diferentes perfis de usuário com relação a: distribuição geográfica, grau de escolaridade, renda familiar, faixa etária e frequência de acesso à web;

- possibilidade de identificação da ocorrência de diferentes padrões de preferências de usuários em função de suas características específicas tais como região geográfica (regionalismo) ou faixa etária;

- integração com ferramentas de rede social como, por exemplo, Facebook ©;

- aplicação da abordagem proposta no redesign da interface de uma aplicação educacional demonstrando de modo prático como o uso do GWIDO pode promover a cultura da participação de usuários no processo de design de interfaces;

- disponibilização do código fonte do ambiente GWIDO e do jogo GWIDO Image junto com a documentação com informações claras e precisas de como desenvolver novos jogos e integrá-los ao ambiente.

6.2 Outras Publicações

Outros artigos publicados durante o período do doutorado, que não compõem este documento, também representam contribuições em seus resultados parciais. A lista destas publicações é apresentada a seguir:

1. Romani, R., Baranauskas, M. C. C. 2009. Jogos com Propósito e Construção de Conhecimento em Design. Technical Report - IC-09-28, IC-Unicamp. p.1-11.

2. Romani, R.; Baranauskas, M. C. C. 2010. GWIDO - Games With Interaction Design Objective. In IADIS International Journal on WWW/Internet 8,1, IADIS. p.1-15.

3. Convidado à submissão de versão estendida do artigo *Exploring Human Computation and Social Computing to inform the Design Process* (Capítulo 2) apresentado na *International Conference on Enterprise Information Systems - ICEIS 2013* para a revista *Management Research News*.

6.3 Trabalhos Futuros

Métodos que promovam a participação massiva de usuários no processo de design de interfaces para todos ainda possuem uma variedade de aspectos a serem explorados, especialmente no que se refere à interseção de HC e SC. Embora esta tese tenha contribuído com uma nova abordagem nesta direção, alguns trabalhos que se pode antecipar para sua continuidade envolvem:

- aumentar a escala de jogadores no GWIDO para a ordem de milhares de pessoas do Brasil e exterior a fim de mapear as diferenças nas escolhas e o impacto delas no design de sistemas multinacionais;
- constituir uma comunidade de designers que façam uso regular do ambiente a fim de manter uma renovação das imagens usadas nas partidas;
- desenvolver novos jogos GWIDO como, por exemplo, o GWIDO Áudio para tratar de componentes de áudio em interfaces especialmente considerando usuários com deficiência visual;
- facilitar no ambiente a autoria de outros jogos GWIDO;
- analisar a colaboração/socialização de um número elevado de designers a fim de identificar a taxa de reaproveitamento de conceitos inseridos no ambiente;
- aplicar técnicas de mineração de dados nos dados coletados pelo jogo a fim de identificar padrões nas preferências dos jogadores que possam ser correlacionadas a características específicas como idade, posição geográfica, frequência de uso da Web, renda familiar ou grau de escolaridade.

Algumas questões limitam o uso de todo o potencial do Ambiente GWIDO. Entre elas está a questão de direitos autorais e licenças de uso das imagens inseridas pelos designers. São permitidos apenas imagens que sejam de autoria do designer ou que estejam sob domínio público ou ainda sob licenças que autorizem o uso, comercial ou não, sem referência à fonte, uma vez que não é possível disponibilizar essa informação para cada imagem no decorrer das partidas.

O rápido crescimento das áreas da computação humana e da computação social no âmbito da pesquisa vem produzindo muitas novas ideias que possibilitam a organização de usuários da Internet para o fazer coletivo. Por outo lado, o design para todos muitas vezes tem sido considerado como um ideal nobre mas inatingivel. Nessa pesquisa acreditamos ter dado um passo na direção desse ideal mostrando que apesar dos obstáculos, existe um grande potencial nas novas tecnologias e também da inteligência coletiva a ser explorado não apenas na busca do ideal do design para todos mas também para o desgin de interfaces de uma maneira mais ampla.

Referências Bibliográficas

[Aggarwal, 2012] Aggarwal, S. (2012). CAPTCHAs with a purpose. Human Computation, AAAI Technical Report WS-12-08.

[Anacleto e de Carvalho, 2008] Anacleto, J. C. e de Carvalho, A. F. P. (2008). Improving human-computer interaction by developing culture-sensitive applications based on common sense knowledge. In Asai, K., editor, *Human Computer Interaction: New Developments*. Intech, Rijeka, Croatia.

[Anacleto et al., 2010a] Anacleto, J. C., Fels, S., e Villena, J. M. R. (2010a). Design of a web-based therapist tool to promote emotional closeness. In *Proceedings of the CHI '10 Extended Abstracts on Human Factors in Computing Systems*, CHI EA '10, pp. 3565–3570, New York, NY, USA. ACM.

[Anacleto et al., 2010b] Anacleto, J. C., Villena, J. M. R., Silva, M. A. R., e Fels, S. (2010b). Culturally sensitive computer support for creative co-authorship of a sex education game. In *Proceedings of the 9th International Conference on Entertainment computing*, ICEC'10, pp. 302–307, Berlin, Heidelberg. Springer-Verlag.

[Apperley, 2006] Apperley, T. (2006). Genre and game studies: Toward a critical approach to video game genres. *Simulation & Gaming*, 37(1):6–23.

[Baranauskas e Souza, 2006] Baranauskas, M. e Souza, C. (2006). Desafio 4 acesso participativo e universal do cidadão brasileiro ao conhecimento. SBC. *Computação Brasil*, ano VII(23):7.

[Baranauskas, 2009] Baranauskas, M. C. C. (2009). Socially aware computing. In *Proceedings of the VI International Conference on Engineering and Computer Education (ICECE 2009)*, pp. 1–5, Buenos Aires, Argentina. COPEC.

[Baranauskas et al., 2008] Baranauskas, M. C. C., Hornung, H. H., e Martins, M. C. (2008). Design socialmente responsável: Desafios de interface de usuário no contexto brasileiro. In *Proceedings of the XXXV SEMISH/CSBC2008*, pp. 91–105.

[Baranauskas et al., 2013] Baranauskas, M. C. C., Martins, M. C., e Valente, J. A., editores (2013). *Codesign de Redes Digitais: Tecnologia e Educação a Serviço da Inclusão Social*. Penso, Porto Alegre, RS, BR.

[Barrington et al., 2009] Barrington, L., O'Malley, D., Turnbull, D., e Lanckriet, G. (2009). User-centered design of a social game to tag music. In *Proceedings of the ACM SIGKDD Workshop on Human Computation*, HCOMP '09, pp. 7–10, New York, NY, USA. ACM.

[Bell et al., 2009] Bell, M., Reeves, S., Brown, B., Sherwood, S., MacMillan, D., Ferguson, J., e Chalmers, M. (2009). Eyespy: supporting navigation through play. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pp. 123–132, New York, NY, USA. ACM.

[Bertelsen, 2006] Bertelsen, O. W. (2006). Tertiary artifacts at the interface. The MIT Press. *Aesthetic computing*, pp. 357–368.

[Bonacin et al., 2010] Bonacin, R., Melo, A. M., Simoni, C. A. C., e Baranauskas, M. C. C. (2010). Accessibility and interoperability in e-government systems: outlining an inclusive development process. Springer-Verlag. *Univers. Access Inf. Soc.*, 9(1):17–33.

[Bry e Wieser, 2012] Bry, F. e Wieser, C. (2012). Squaring and scripting the ESP game: Trimming a gwap to deep semantics. In Ma, M., Oliveira, M., Hauge, J., Duin, H., e Thoben, K.-D., editores, *Serious Games Development and Applications*, volume 7528 of *Lecture Notes in Computer Science*, pp. 183–192. Springer Berlin Heidelberg.

[Carvalho et al., 2006] Carvalho, A. C. P. d. L. F. d., Brayner, A., Loureiro, A., e et al (2006). Grandes desafios da pesquisa em computação no brasil de 2006 a 2016. Relatório técnico, Sociedade Basileira de Computação (SBC), Porto Alegre, RS.

[Casey et al., 2007] Casey, S., Kirman, B., e Rowland, D. (2007). The gopher game: a social, mobile, locative game with user generated content and peer review. In *Proceedings of the International Conference on Advances in computer entertainment technology*, ACE '07, pp. 9–16, New York, NY, USA. ACM.

[Chamberlain et al., 2012] Chamberlain, J., Kruschwitz, U., Poesio, M., e Al, E. (2012). Motivations for participation in socially networked collective intelligence systems. *CoRR*, abs/1204.4071.

[Choi et al., 2006] Choi, Y. S., Yi, J. S., Law, C. M., e Jacko, J. A. (2006). Are "universal design resources"designed for designers? In *Proceedings of the 8th International ACM*

SIGACCESS conference on Computers and accessibility, Assets '06, pp. 87–94, New York, NY, USA. ACM.

[Chorianopoulos e Spinellis, 2006] Chorianopoulos, K. e Spinellis, D. (2006). User interface evaluation of interactive TV: a media studies perspective. Springer-Verlag. *Univers. Access Inf. Soc.*, 5(2):209–218.

[Crawford, 1984] Crawford, C. (1984). *The Art of Computer Game Design*. Osborne/McGraw-Hill, New York, USA.

[Dasdan et al., 2009] Dasdan, A., Drome, C., Kolay, S., Alpern, M., Han, A., Chi, T., Hoover, J., Davtchev, I., e Verma, S. (2009). Thumbs-up: a game for playing to rank search results. In *Proceedings of the ACM SIGKDD Workshop on Human Computation*, HCOMP '09, pp. 36–37, New York, NY, USA. ACM.

[e Cidadania, 2008] e Cidadania (2008). e-cidadania. http://www.nied.unicamp.br/ecidadania. Retrieved: march, 2009.

[Erickson, 2013] Erickson, T. (2013). *Social Computing*. The Interaction Design Foundation, Aarhus, Denmark.

[Feng et al., 2012] Feng, J., Ni, Y., Dong, J., Wang, Z., e Yan, S. (2012). Purposive hidden-object-game: Embedding human computation in popular game. IEEE Computer Society. *Multimedia, IEEE Transactions*, 14(5):1496 – 1507.

[Goh et al., 2010] Goh, D. H.-L., Lee, C. S., e Chua, A. Y.-K. (2010). Do games motivate mobile content sharing? In *Proceedings of the role of digital libraries in a time of global change, and 12th International Conference on Asia-Pacific digital libraries*, ICADL'10, pp. 61–70, Berlin, Heidelberg. Springer-Verlag.

[Goh et al., 2011] Goh, D. H.-L., Razikin, K., Chua, A. Y. K., Lee, C. S., e Tan, K.-T. (2011). Understanding location-based information sharing in a mobile human computation game. In *Proceedings of the 2011 International Conference on Internet of Things and 4th International Conference on Cyber, Physical and Social Computing*, ITHINGSCPSCOM '11, pp. 209–216, Washington, DC, USA. IEEE Computer Society.

[Gungor, 2012] Gungor, T. (2012). Input-evaluation: A new mechanism for collecting data using games with a purpose. In *Proceedings of the IEEE Symposium on Computers and Communications (ISCC)*, ISCC '12, pp. 239–244, Washington, DC, USA. IEEE Computer Society.

[Guy et al., 2011] Guy, I., Perer, A., Daniel, T., Greenshpan, O., e Turbahn, I. (2011). Guess who?: enriching the social graph through a crowdsourcing game. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '11, pp. 1373–1382, New York, NY, USA. ACM.

[Hacker e von Ahn, 2009] Hacker, S. e von Ahn, L. (2009). Matchin: eliciting user preferences with an online game. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pp. 1207–1216, New York, NY, USA. ACM.

[Harrison et al., 2007] Harrison, S., Tatar, D., e Sengers, P. (2007). The three paradigms of HCI. In *Proceedings of the Alternative CHI Session at the SIGCHI Conference on Human Factors in Computing Systems*, pp. 1–18, California, USA.

[Hartson et al., 1996] Hartson, H. R., Castillo, J. C., Kelso, J., e Neale, W. C. (1996). Remote evaluation: the network as an extension of the usability laboratory. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '96, pp. 228–235, New York, NY, USA. ACM.

[Hasbro, 2012] Hasbro (2012). Instructions, taboo. http://hasbro.com/common/instruct/Taboo(2000).PDF. Retrieved: August, 2012.

[Hayashi e Baranauskas, 2008] Hayashi, E. C. S. e Baranauskas, M. C. C. (2008). Facing the digital divide in a participatory way - an exploratory study. In Forbrig, P., Paternò, F., e Pejtersen, A., editores, *Human-Computer Interaction Symposium*, volume 272 of *IFIP International Federation for Information Processing*, pp. 143–154. Springer US.

[Hebecker e Ebbert, 2010] Hebecker, R. e Ebbert, C. (2010). Creation and validation of symbols with purposeful games and online survey. In *Proceedings of the 1st DESIRE Network Conference on Creativity and Innovation in Design*, DESIRE '10, pp. 112–120, Lancaster, UK, UK. Desire Network.

[Ho et al., 2009] Ho, C.-J., Chang, T.-H., Lee, J.-C., Hsu, J. Y.-j., e Chen, K.-T. (2009). Kisskissban: a competitive human computation game for image annotation. In *Proceedings of the ACM SIGKDD Workshop on Human Computation*, HCOMP '09, pp. 11–14, New York, NY, USA. ACM.

[Hornung et al., 2008] Hornung, H. H., Baranauskas, M. C. C., e de Andrade Tambascia, C. (2008). Assistive technologies and techniques for web-based egov in developing countries. In *Proceedings of the 10th International Conference on Enterprise Information Systems*, pp. 248–255, Barcelona, Spain. INSTICC Press.

[Howe, 2008] Howe, J. (2008). *Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business*. Crown Publishing Group, New York, NY, USA, 1 edition.

[Hu et al., 2011] Hu, C., Bederson, B. B., Resnik, P., e Kronrod, Y. (2011). Monotrans2: a new human computation system to support monolingual translation. In *Proceedings of the* SIGCHI *Conference on Human Factors in Computing Systems*, CHI '11, pp. 1133–1136, New York, NY, USA. ACM.

[IBGE, 2005] IBGE (2005). Acesso à internet e posse de telefone móvel celular para uso pessoal. Instituto Brasileiro de Geografia e Estatística. Acessado em: Setembro de 2013.

[IBGE, 2011] IBGE (2011). Acesso à internet e posse de telefone móvel celular para uso pessoal 2011. Instituto Brasileiro de Geografia e Estatística. Acessado em: Setembro de 2013.

[Islam et al., 2010] Islam, M. T., Nahiduzzaman, K. M., Why, Y. P., e Ashraf, G. (2010). Learning character design from experts and laymen. In *Proceedings of the International Conference on Cyberworlds*, CW '10, pp. 134–141, Washington, DC, USA. IEEE Computer Society.

[Jain e Parkes, 2009] Jain, S. e Parkes, D. C. (2009). The role of game theory in human computation systems. In *Proceedings of the ACM SIGKDD Workshop on Human Computation*, HCOMP '09, pp. 58–61, New York, NY, USA. ACM.

[Kothandapani et al., 2012] Kothandapani, S., Goh, D. H.-L., e Razikin, K. (2012). Influence of playability and usability in a mobile human computation game. In *Proceedings of the 32nd International Conference on Distributed Computing Systems Workshops*, ICDCSW '12, pp. 75–78, Washington, DC, USA. IEEE Computer Society.

[Krause et al., 2010] Krause, M., Takhtamysheva, A., Wittstock, M., e Malaka, R. (2010). Frontiers of a paradigm: exploring human computation with digital games. In *Proceedings of the ACM SIGKDD Workshop on Human Computation*, HCOMP '10, pp. 22–25, New York, NY, USA. ACM.

[Kuo et al., 2009] Kuo, Y.-l., Lee, J.-C., Chiang, K.-y., Wang, R., Shen, E., Chan, C.-w., e Hsu, J. Y.-j. (2009). Community-based game design: experiments on social games for commonsense data collection. In *Proceedings of the ACM SIGKDD Workshop on Human Computation*, HCOMP '09, pp. 15–22, New York, NY, USA. ACM.

[Law e von Ahn, 2009] Law, E. e von Ahn, L. (2009). Input-agreement: a new mechanism for collecting data using human computation games. In *Proceedings of the SIGCHI*

Conference on Human Factors in Computing Systems, CHI '09, pp. 1197–1206, New York, NY, USA. ACM.

[Lux et al., 2010] Lux, M., Böszörmenyi, L., e Müller, A. (2010). A social approach to image re-targeting based on an interactive game. In *Proceedings of the 6th International Conference on HCI in work and learning, life and leisure: workgroup human-computer interaction and usability engineering*, USAB'10, pp. 465–470, Berlin, Heidelberg. Springer-Verlag.

[Malone et al., 2009] Malone, T. W., Laubacher, R., e Dellarocas, C. (2009). Harnessing crowds: Mapping the genome of collective intelligence. *MIT Sloan Research Paper No. 4732-09*.

[Matyas et al., 2008] Matyas, S., Matyas, C., Schlieder, C., Kiefer, P., Mitarai, H., e Kamata, M. (2008). Designing location-based mobile games with a purpose: collecting geospatial data with cityexplorer. In *Proceedings of the International Conference on Advances in Computer Entertainment Technology*, ACE '08, pp. 244–247, New York, NY, USA. ACM.

[McCarthy e Wright, 2004] McCarthy, J. e Wright, P. (2004). Technology as experience. ACM. *interactions*, 11(5):42–43.

[Medhi, 2007] Medhi, I. (2007). User-centered design for development. ACM. *interactions*, 14(4):12–14.

[Muller, 2003] Muller, M. J. (2003). The human-computer interaction handbook. chapter Participatory design: the third space in HCI, pp. 1051–1068. L. Erlbaum Associates Inc., Hillsdale, NJ, USA.

[Nagy, 2011] Nagy, B. (2011). Acquisition of semantic metadata via an interactive game. In *Proceedings of the 9th Spring 2011 PeWe Workshop*, pp. 63–64, Vinicné, Slovakia. Slovak University of Technology.

[NCSU, 2008] NCSU (2008). The center for universal design. http://www.design.ncsu.edu/cud/index.htm. North Carolina State University. Acessado em: fev. 2009.

[NICBR, 2012] NICBR (2012). Pesquisa TIC domicílios 2012. Núcleo de Informação e Coordenação do Ponto BR. Acessado em: Setembro de 2013.

[Nielsen e Molich, 1990] Nielsen, J. e Molich, R. (1990). Heuristic evaluation of user interfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '90, pp. 249–256, New York, NY, USA. ACM.

[Norman, 2004] Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things.* Basic books, New York, USA.

[Norman e Draper, 1986] Norman, D. A. e Draper, S. W. (1986). *User Centered System Design: New Perspectives on Human-Computer Interaction.* L. Erlbaum Associates Inc., Hillsdale, NJ, USA.

[Oomen et al., 2010] Oomen, J., Belice Baltussen, L., Limonard, S., van Ees, A., Brinkerink, M., Aroyo, L., Vervaart, J., Asaf, K., e Gligorov, R. (2010). Emerging practices in the cultural heritage domain - social tagging of audiovisual heritage. In *Proceedings of the WebSci10: Extending the Frontiers of Society On-Line*, Raleigh, NC, US. University of Southampton.

[Parameswaran e Whinston, 2007] Parameswaran, M. e Whinston, A. B. (2007). Social computing: An overview. *CAIS*, 19/37:762–780.

[Pearl e Steyvers, 2010] Pearl, L. e Steyvers, M. (2010). Identifying emotions, intentions, and attitudes in text using a game with a purpose. In *Proceedings of the NAACL HLT 2010 Workshop on Computational Approaches to Analysis and Generation of Emotion in Text*, CAAGET '10, pp. 71–79, Stroudsburg, PA, USA. Association for Computational Linguistics.

[Quinn e Bederson, 2011] Quinn, A. J. e Bederson, B. B. (2011). Human computation: a survey and taxonomy of a growing field. In *Proceedings of the* SIGCHI *Conference on Human Factors in Computing Systems*, CHI '11, pp. 1403–1412, New York, NY, USA. ACM.

[Rafelsberger e Scharl, 2009] Rafelsberger, W. e Scharl, A. (2009). Games with a purpose for social networking platforms. In *Proceedings of the 20th ACM conference on Hypertext and hypermedia*, HT '09, pp. 193–198, New York, NY, USA. ACM.

[Rashid et al., 2009] Rashid, A., Wiesenberger, J., Meder, D., Baumann, J., e Informatik, F. F. (2009). PRIMIUM - *Process Innovation for Enterprise Software*, volume P-151 of *Lecture Notes in Informatics (LNI)*. Koellen-Verlag, Bonn.

[Romani e Baranauskas, 2009] Romani, R. e Baranauskas, M. C. C. (2009). GWIDO - games with interaction design objective. In *Proceedings of the* IADIS *International Conference WWW/Internet*, WWW/Internet, pp. 351–358, Lisboa, Portugal. IADIS.

[Romani e Baranauskas, 2010] Romani, R. e Baranauskas, M. C. C. (2010). GWIDO - games with interaction design objective. IADIS. *IADIS International Journal on WWW/Internet*, 8(1):1–15.

[Romani e Baranauskas, 2012] Romani, R. e Baranauskas, M. C. C. (2012). Helping designers in making choices through games. In *Proceedings of the 11th Brazilian Symposium on Human Factors in Computing Systems*, IHC '12, pp. 229–238, Porto Alegre, Brazil. Brazilian Computer Society.

[Romani e Baranauskas, 2013] Romani, R. e Baranauskas, M. C. C. (2013). Exploring human computation and social computing to inform the design process. In *Proceedings of the International Conference on Enterprise Information Systems*, ICEIS 2013, pp. 44–51, Angers, France. INSTICC Press.

[Romani et al., 2013] Romani, R., Gutiérrez, J. E., e Baranauskas, M. C. C. (2013). Putting GWIDO in use: promoting the culture of participation in the redesign of an educational application. In *Proceedings of the 12th Brazilian Symposium on Human Factors in Computing Systems*, IHC '13, pp. 158–167, Porto Alegre, Brazil. Brazilian Computer Society.

[Scharl et al., 2012] Scharl, A., Sabou, M., e Föls, M. (2012). Climate quiz: a web application for eliciting and validating knowledge from social networks. In *Proceedings of the 18th Brazilian symposium on Multimedia and the web*, WebMedia '12, pp. 189–192, New York, NY, USA. ACM.

[Schuler e Namioka, 1993] Schuler, D. e Namioka, A., editores (1993). *Participatory Design: Principles and Practices*. L. Erlbaum Associates Inc., Hillsdale, NJ, USA.

[Segaran, 2007] Segaran, T. (2007). *Programming collective intelligence*. O'Reilly, Sebastopol, CA, USA, first edition.

[seriousgames.org, 2002] seriousgames.org (2002). Serious game initiative. http://www.seriousgames.org. Retrieved: march, 2009.

[Shehab et al., 2012] Shehab, M., Ko, M. N., e Touati, H. (2012). Social networks profile mapping using games. In *Proceedings of the 3rd USENIX conference on Web Application Development*, WebApps'12, pp. 3–3, Berkeley, CA, USA. USENIX Association.

[Simko et al., 2011] Simko, J., Tvarozek, M., e Bielikova, M. (2011). Little search game: term network acquisition via a human computation game. In *Proceedings of the 22nd ACM conference on Hypertext and hypermedia*, HT '11, pp. 57–62, New York, NY, USA. ACM.

[Siorpaes e Hepp, 2008] Siorpaes, K. e Hepp, M. (2008). Games with a purpose for the semantic web. IEEE Educational Activities Department. *IEEE Intelligent Systems*, 23(3):50–60.

[Steinmayr et al., 2011] Steinmayr, B., Wieser, C., Kneissl, F., e Bry, F. (2011). Karido: A GWAP for telling artworks apart. In *Proceedings of the 2011 16th International Conference on Computer Games*, CGAMES '11, pp. 193–200, Washington, DC, USA. IEEE Computer Society.

[Stevens et al., 2009] Stevens, G., Pipek, V., e Wulf, V. (2009). Appropriation infrastructure: Supporting the design of usages. In *Proceedings of the 2nd International Symposium on End-User Development*, IS-EUD '09, pp. 50–69, Berlin, Heidelberg. Springer-Verlag.

[Takahashi, 2000] Takahashi, T., editor (2000). *Sociedade da Informação no Brasil - Livro Verde*. Ministério da Ciência e Tecnologia, Brasilia, DF, Brasil.

[Taktamysheva et al., 2011] Taktamysheva, A., Krause, M., Smeddinck, J., e Al, E. (2011). Serious questionnaires in playful social network applications. In *Proceedings of the 10th International Conference on Entertainment Computing*, ICEC'11, pp. 436–439, Berlin, Heidelberg. Springer-Verlag.

[Thaler et al., 2011] Thaler, S., Simperl, E., e Siorpaes, K. (2011). Spotthelink: playful alignment of ontologies. In *Proceedings of the ACM Symposium on Applied Computing*, SAC '11, pp. 1711–1712, New York, NY, USA. ACM.

[Tsai e Yang, 2011] Tsai, T.-C. e Yang, T.-R. (2011). GWAP design for a mobile geotagging system with confident verification. In *Proceedings of the 2011 14th IEEE International Conference on Computational Science and Engineering*, CSE '11, pp. 302–307, Washington, DC, USA. IEEE Computer Society.

[Tuite et al., 2010] Tuite, K., Snavely, N., Hsiao, D.-Y., Smith, A. M., e Popović, Z. (2010). Reconstructing the world in 3d: bringing games with a purpose outdoors. In *Proceedings of the Fifth International Conference on the Foundations of Digital Games*, FDG '10, pp. 232–239, New York, NY, USA. ACM.

[Tuite et al., 2011] Tuite, K., Snavely, N., Hsiao, D.-y., Tabing, N., e Popovic, Z. (2011). Photocity: training experts at large-scale image acquisition through a competitive game. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '11, pp. 1383–1392, New York, NY, USA. ACM.

[Van Kleek et al., 2012] Van Kleek, M., Smith, D., Stranders, R., e schraefel, m. (2012). Twiage: a game for finding good advice on twitter. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '12, pp. 889–898, New York, NY, USA. ACM.

[von Ahn, 2005] von Ahn, L. (2005). *Human Computation*. Doctoral thesis, umi order number: Aai3205378, CMU, USA.

[von Ahn, 2006] von Ahn, L. (2006). Games with a purpose. IEEE Computer Society Press. *Computer*, 39(6):92–94.

[von Ahn, 2007] von Ahn, L. (2007). Human computation. In *Proceedings of the 4th International Conference on Knowledge capture*, K-CAP '07, pp. 5–6, New York, NY, USA. ACM.

[von Ahn, 2008] von Ahn, L. (2008). Popvideo. http://www.gwap.com/gwap/games Preview/popvideo/. Acessado em fevereiro de 2009.

[von Ahn, 2009] von Ahn, L. (2009). Human computation. In *Proceedings of the 46th Annual Design Automation Conference*, DAC '09, pp. 418–419, New York, NY, USA. ACM.

[von Ahn e Dabbish, 2004] von Ahn, L. e Dabbish, L. (2004). Labeling images with a computer game. In *Proceedings of the* SIGCHI *Conference on Human Factors in Computing Systems*, CHI '04, pp. 319–326, New York, NY, USA. ACM.

[von Ahn e Dabbish, 2008] von Ahn, L. e Dabbish, L. (2008). Designing games with a purpose. ACM. *Commun. ACM*, 51(8):58–67.

[von Ahn et al., 2007] von Ahn, L., Ginosar, S., Kedia, M., e Blum, M. (2007). Improving image search with PHETCH. In *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing*, pp. IV–1209 – IV–1212, Los Alamitos, CA, USA. IEEE Computer Society.

[von Ahn et al., 2006a] von Ahn, L., Kedia, M., e Blum, M. (2006a). Verbosity: a game for collecting common-sense facts. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '06, pp. 75–78, New York, NY, USA. ACM.

[von Ahn et al., 2006b] von Ahn, L., Liu, R., e Blum, M. (2006b). Peekaboom: a game for locating objects in images. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '06, pp. 55–64, New York, NY, USA. ACM.

[W3C, 2008] W3C (2008). Web content accessibility guidelines (WCAG) 2.0. http://www.w3.org/TR/WCAG20. Retrieved: march, 2009.

[Walsh e Golbeck, 2010] Walsh, G. e Golbeck, J. (2010). Curator: a game with a purpose for collection recommendation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '10, pp. 2079–2082, New York, NY, USA. ACM.

[Wang et al., 2007] Wang, F.-Y., Carley, K. M., Zeng, D., e Mao, W. (2007). Social computing: From social informatics to social intelligence. IEEE Computer Society. *Intelligent Systems*, 22(2):79–83.

[Weng et al., 2011] Weng, L., Schifanella, R., Menczer, F., e Al, E. (2011). Design of social games for collecting reliable semantic annotations. In *Proceedings of the 16th International Conference on Computer Games*, CGAMES '11, pp. 185–192, Washington, DC, USA. IEEE Computer Society.

Apêndice A

Descrição do sistema

A.1 Descrição do Funcionamento do GWIDO Image e Ambiente

O GWIDO Image possui basicamente dois tipos de usuários que podem interagir com o sistema: os jogadores e os designers. Os designers são responsáveis por cadastrar os conceitos no jogo e as imagens associadas a eles. Estes conceitos são sorteados aleatoriamente e apresentados para os jogadores durante as partidas.

Em cada partida do jogo, dois jogadores são escolhidos (pelo sistema) para compor uma nova partida que tem a duração de 1 minuto e 30 segundos sendo composta por rounds. Em cada round é exibido um novo conceito com suas respectivas imagens. Cada jogador escolhe a imagem que melhor representa o conceito para ele. Se os jogadores escolherem a mesma imagem, ambos os jogadores marcam pontos e o bônus de acerto consecutivo é incrementado. Caso contrário, o bônus é zerado mas ninguém perde pontos. Ao término da partida, é exibida uma tela com o resumo da partida, mostrando as imagens escolhidas, suas respectivas pontuações e a posição do jogador no ranking geral. Também são armazenadas e processadas todas as escolhas dos jogadores para que, futuramente, sejam exibidas em forma de estatísticas para os designers.

Os designers também podem exercer o papel de jogadores. Os designers podem acessar em sua área reservada os conceitos criados por eles. Esse acesso permite a criação de novos conceitos, edição e exclusão. Além disso, eles podem visualizar as estatísticas dos conceitos cadastrados por eles. Do ponto de vista dos designers, as estatísticas são a ferramenta principal do GWIDO Image. Elas proporcionam uma visão geral de quais imagens representam melhor cada conceito de acordo com a opinião dos jogadores, ou seja, quantas vezes ele foi jogado e o número de vezes que as imagens foram escolhidas. Além disso, oferecem uma visão específica de cada imagem em relação ao perfil dos jogadores que

as escolheram. Entre essas informações específicas estão: região geográfica, faixa etária, faixa social, familiaridade com uso de internet e escolaridade. É importante evidenciar que essas informações só podem ser obtidas se os jogadores as fornecerem no momento do cadastro, exceto a região geográfica que pode ser inferida a partir do IP da máquina do usuário.

A.1.1 Telas do sistema

A seguir serão apresentadas as telas, tanto do jogo GWIDO Image quanto do ambiente GWIDO. Para cada tela será apresentada uma descrição contendo suas principais funcionalidades e características.

Página inicial

É a primeira página do ambiente, a partir da qual o usuário pode cadastrar-se, acessar sua conta, obter informações sobre o jogo, iniciar uma partida e visualizar o ranking dos 10 jogadores com maior pontuação (Figura A.1). O layout desta tela é mantido em todo o ambiente. Foi elaborado para ser simples e evidenciar o conteúdo do jogo.

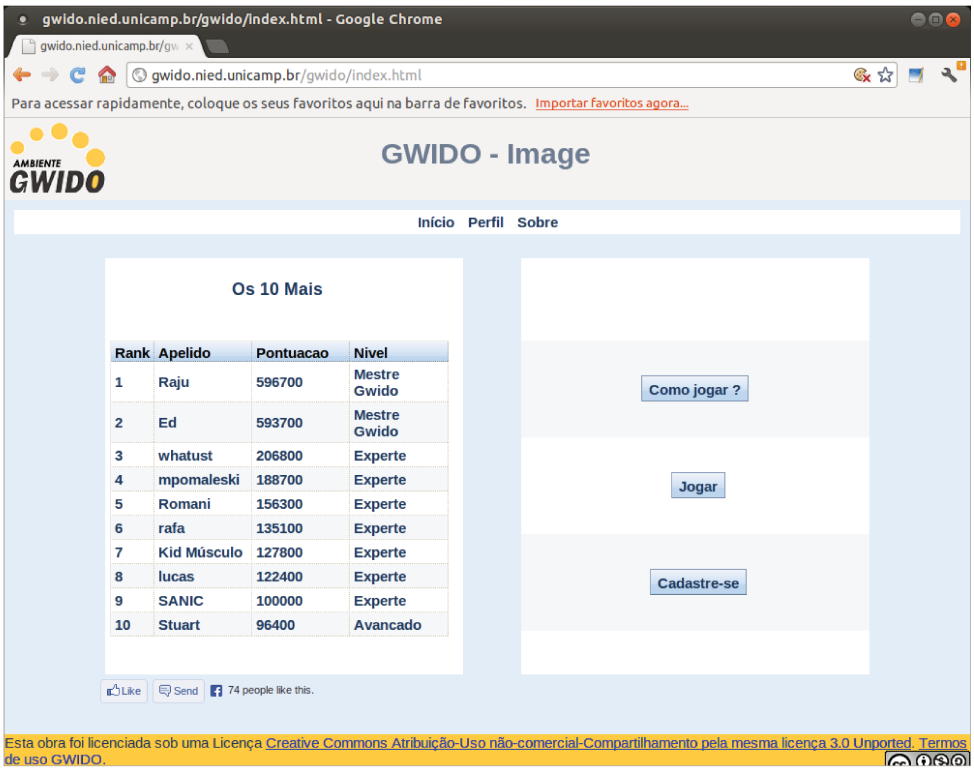

Figura A.1: Tela inicial do GWIDO

Cadastro

Esta página possibilita o cadastro de novos usuários (Figura A.2). Para o cadastro o usuário deve informar o tipo de cadastro (jogador ou designer e jogador), nome, apelido (usado durante o login), email, senha, data de nascimento, grau de instrução, acesso à internet e faixa social sendo que os três últimos não são obrigatórios. As informações optativas, se fornecidas, proporcionam um grau de detalhamento maior aos designers no momento da avaliação de seus conceitos cadastrados. Os usuários também devem ler e aceitar os termos de uso do sistema para que possam realizar o cadastro.

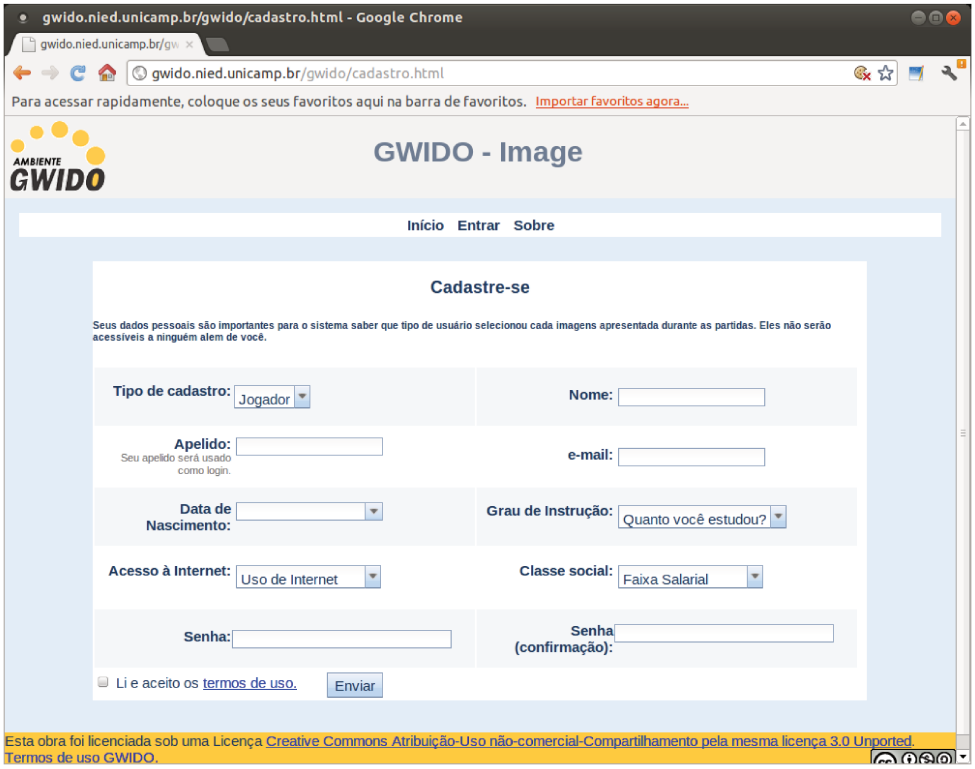

Figura A.2: Tela de cadastro de usuários

Tela de Espera

Após o cadastro, o jogador pode entrar para jogar. Ao clicar no botão jogar, o usuário é direcionado para a tela de espera (Figura A.3). Neste momento, o engine do GWIDO Image procura algum outro jogador para iniciar uma nova partida. Caso nenhum jogador seja encontrado em até aproximadamente 7 segundos, uma nova partida é iniciada com um simulador. Este simulador é uma cópia de alguma partida realizada anteriormente com jogadores reais que é armazenada como uma forma de simular as opiniões de um jogador real. Mais detalhes sobre o simulador são apresentados no Anexo B.

Figura A.3: Tela de espera por um parceiro para a partida

Tela de Jogo

Tela que apresenta os conceitos para cada partida. Esta tela apresenta um banner superior contendo o nome do conceito (ao centro), a pontuação, ou seja, o bônus (à esquerda) e o tempo corrente (à direita). As imagens associadas ao conceito aparecem logo abaixo, incluindo uma imagem que representa "Nenhuma das Imagens Anteriores" também chamada de skip (do inglês, passar), aparece ao final das imagens em todos os conceitos (Figura A.4). Assim que os dois jogadores escolhem a imagem, uma mensagem é exibida por um curto período de tempo, avisando o acerto ou erro. Se ambos escolherem a mesma imagem, os dois marcam pontos. Caso escolham imagens diferentes, o bônus é zerado.

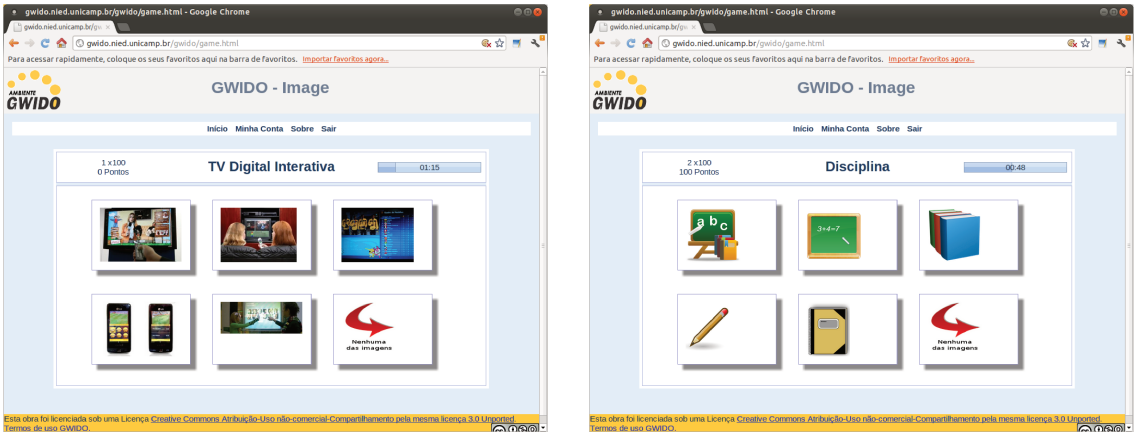

Figura A.4: Exemplos de tela de um round em uma partida

Tela de Resumo

Após 1 minuto e 30 segundos, a partida se encerra e o jogador é redirecionado para uma tela com o resumo da partida. O resumo inclui as imagens escolhidas pelo jogador e seu parceiro, a pontuação na partida, a pontuação total no GWIDO Image e o ranking geral do jogador (Figura A.5).

Figura A.5: Exemplo de tela de resumo ao final da partida

Minha Conta

A área minha conta só pode ser acessada por jogadores cadastrados. Nesta tela, o usuário do tipo "Jogador" pode acessar as abas: "Dados Pessoais", "Meu Gwido" e "Trocar Senha". O usuário do tipo "Designer e Jogador" tem acesso a mais uma aba denominada "Meus Conceitos". A aba "Dados Pessoais" é dedicada ao acesso e alteração dos dados de usuário informados no momento do cadastro (Figura A.6 - 1ª tela). A aba "Meu Gwido" exibe a posição do jogador no ranking geral e as duas posições imediatamente acima e abaixo. Além disso, exibe também o nível do jogador, sua pontuação atual e a quantidade de pontos para o próximo nível. Um texto que explica detalhes das regras e sistema de pontos durante a partida também são apresentados. A aba "Trocar Senha" permite que o usuário altere sua senha no ambiente. A aba "Meus Conceitos"permite ao usuário do tipo "Designer e Jogador" criar e editar conceitos (Figura A.6 - 2ª tela). Para cada conceito existente é exibido o título, o número de imagens, a data de criação e os botões: editar, excluir e estatísticas.

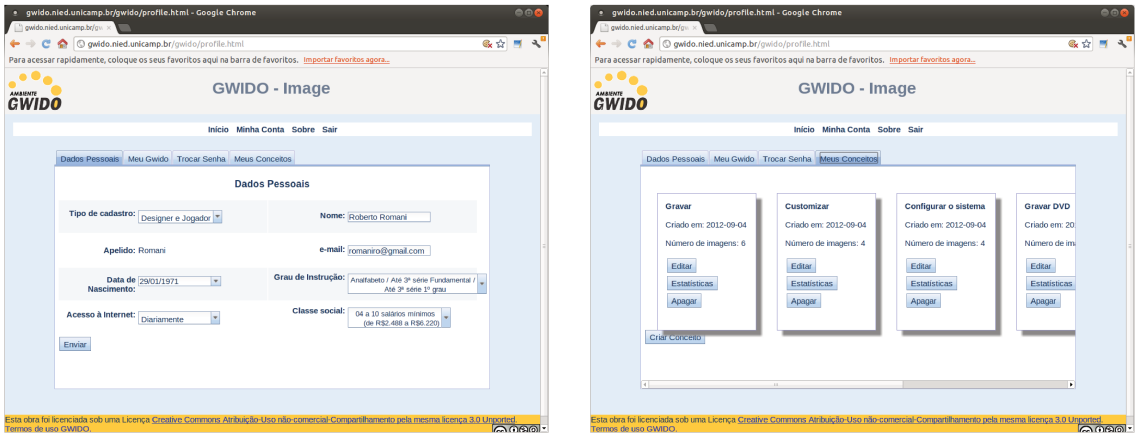

Figura A.6: Tela Minha Conta na aba Dados Pessoais

Tela de Estatísticas

Permite aos designers visualizar as estatísticas associadas a cada conceito. Nesta tela (Figura A.7 - 1ª tela), é exibido o título do conceito, o número de escolhas, desistências (skips) e acertos na parte superior. Na parte central da tela é exibido um gráfico do tipo pizza para as escolhas de cada imagem. Ao lado é apresentada uma tabela com as informações do número de escolhas e de acertos de cada imagem. O designer pode querer mais detalhes sobre algumas imagens específicas, tais como a distribuição social, regional e educacional das pessoas que as escolheram (Figura A.7 - 2ª tela). Isso pode ser feito selecionando-se as imagens e clicando no botão "Detalhes" abaixo da tabela.

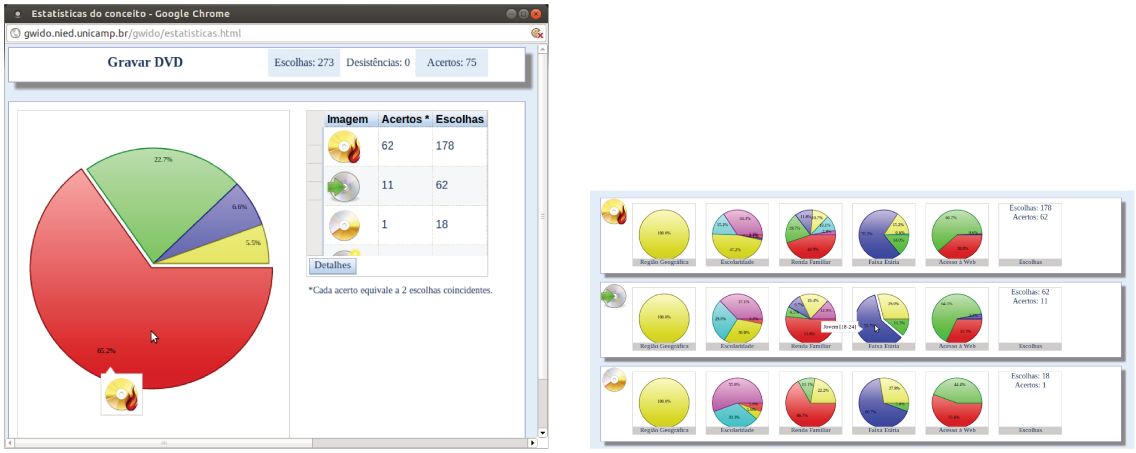

Figura A.7: Tela do módulo de Estatísticas

Apêndice B

Sobre a implementação do GWIDO

B.1 Visão Geral

Após a criação de um protótipo inicial em HTML, que foi avaliado por usuários, iniciou-se a implementação do ambiente GWIDO e do jogo GWIDO Image com a participação de um aluno de graduação com bolsa de iniciação científica[1]. Em uma primeira implementação o controle das partidas foi feito armazenando as informações para gerenciamento da partida diretamente no banco de dados usando-se operações atômicas. Após alguns testes essa solução mostrou-se ineficiente devido à dinâmica do jogo exigir respostas mais rápidas. Isso ocorria principalmente quando havia mais de uma dupla acessando o jogo simultaneamente. Como solução foi feita uma nova implementação com base em servlets mantendo-se assim todos os dados das partidas em andamento em memória procedendo à gravação em banco de dados apenas ao final de cada partida. Essa solução mostrou-se mais estável, e escalonável deixando as respostas do jogo mais rápidas.

O desenvolvimento do GWIDO foi dividido em três módulos: o ambiente GWIDO, o módulo de estatísticas e o módulo do jogo GWIDO Image. O ambiente GWIDO possui as funcionalidades de acesso inicial ao sistema com autenticação própria e integração com redes sociais como o facebook ©, cadastro de usuários, acesso à conta dos jogadores e designers e acesso ao módulo de estatísticas. O módulo do GWIDO Image se refere às funções relacionadas com o jogo, tais como, a engine, a criação de partidas, seu gerenciamento e encerramento. O módulo de estatísticas tem a função de disponibilizar os dados coletados aos designers.

A implementação do jogo como um módulo do ambiente teve o objetivo de possibilitar a inserção de novos jogos sem a necessidade de reimplementações no ambiente. Além disso, as especificidades técnicas do ambiente e do jogo também motivaram a

[1] José Henrique Marcon de Carvalho Leite, com bolsa PIBIC/CNPq - de 8/2011 a 7/2012

proposição desta arquitetura para o sistema. O Ambiente GWIDO foi projetado em uma arquitetura cliente/servidor para web, utilizando o servidor Apache[2] como webserver, HTML/CSS para a definição do layout do ambiente, AJAX[3] e scripts PHP[4] para as requisições cliente/servidor. A engine do GWIDO Image foi projetada utilizando servlet, com Apache Tomcat[5] como servlet container. O detalhamento dos recursos utilizados é definido a seguir.

Servidores Web têm como função primária responder a requisições de páginas web utilizando protocolo Hypertext Transfer Protocol (HTTP). Um cliente web, comumente um navegador web inicia a comunicação fazendo uma requisição por um recurso específico usando HTTP e o servidor responde com o conteúdo requisitado ou com uma mensagem de erro se não conseguir fazê-lo. O recurso é tipicamente algum arquivo existente no servidor. Outra função dos servidores web é receber conteúdo dos clientes, como por exemplo, o envio de formulários ou upload de arquivos. Alguns servidores web, como Apache, são capazes também de executar scripts, que são pequenos programas executáveis para realizar tarefas específicas, sendo responsáveis por gerar conteúdo dinamicamente para as páginas web. No desenvolvimento do GWIDO, os scripts foram escritos em linguagem PHP. Outro recurso que também está relacionado às requisições dos clientes e às respostas do servidor web é o modo como essas requisições são feitas. No ambiente GWIDO tais requisições são feitas por meio do Asynchronous Javascript e XML (AJAX), uma metodologia de programação web na qual o cliente pode fazer requisições assíncronas ao servidor.

Para o desenvolvimento da interface (elementos de interface) do Ambiente GWIDO foi utilizado o Dojo Toolkit[6]. Dojo é um framework de desenvolvimento web baseado em javascript, de código fonte aberto, projetado para facilitar o desenvolvimento de websites. O framework possui diversos componentes, chamados widgets, amplamente utilizados nas aplicações. Dojo também conta com suporte aos navegadores mais utilizados atualmente, como Internet Explorer, Mozilla Firefox, Google Chrome, Opera, além de plataformas móveis como Ipad, Iphone e Android, o que permite o desenvolvimento de um sistema cross-browser. Outros frameworks como o jquery também foram avaliados, mas o fator mais importante que definiu a escolha pelo Dojo foi a incorporação de aspectos de acessibilidade que esse framework oferece nativamente. Dentre estes recursos estão o acesso via teclado e mouse, identificação das funcionalidades independente de cores ou tamanho de fonte e possibilidade de utilização de tecnologia assistiva de acordo com a especificação ARIA[7].

[2]The Apache Foundation, http://projects.apache.org/
[3]AJAX, http://en.wikipedia.org/wiki/Ajax_(programming)
[4]PHP, HyperText Processor, http://www.php.net/
[5]Apache Tomcat, http://tomcat.apache.org/
[6]Dojo Toolkit, http://dojotoolkit.org/
[7]ARIA, http://www.w3.org/WAI/intro/aria.php

A arquitetura de servlets escolhida para o desenvolvimento do engine do GWIDO Image assemelha-se bastante com a de webservers utilizada no ambiente GWIDO, porém possui algumas diferenças essenciais que possibilitaram a produção do engine com maior estabilidade e desempenho. Em linhas gerais, o servlet é um componente que roda do lado do servidor web, gerando dados para a camada de aplicação web. Basicamente é uma classe na linguagem de programação Java que processa requisições e respostas dos clientes web dinamicamente. O servidor web Apache Tomcat, foi desenvolvido especificamente para rodar servlets implementados na linguagem Java. A classe tipicamente usada para implementação de servlets é a servlet container, que foi usada no desenvolvimento do GWIDO. O Apache Tomcat é uma aplicação de código aberto para as tecnologias Java Servlet e Java Server Pages (JSPs). As especificações Java Servelts e JSPs são desenvolvidas sob a licença Apache Licence version2[8].

B.1.1 Metodologia de Desenvolvimento

O método de desenvolvimento foi baseado em metodologias de desenvolvimento ágeis[9]. Essas metodologias tentam em geral minimizar o risco do desenvolvimento de software em curtos períodos, chamados de iteração. Esses períodos duram tipicamente de uma a quatro semanas. Cada iteração é como um projeto de software em escala menor, e inclui todas as tarefas necessárias para implantar esse mini-projeto tais como planejamento, análise de requisitos, projeto, codificação e teste. Uma característica presente em metodologias ágeis é a ênfase na comunicação entre as partes envolvidas no projeto, preferencialmente face a face e que acontecem comumente no inicio e fim de cada iteração, ou com o surgimento de alguma necessidade específica. No desenvolvimento do GWIDO foi adotada uma adaptação de ideias comuns a metodologias ágeis, pois o número de pessoas no desenvolvimento foi bastante reduzido. Reuniões semanais eram realizadas com o intuito de avaliar o ciclo anterior realizado e planejar os próximos passos.

B.2 Detalhes Técnicos da Implementação

Outro desafio do desenvolvimento do GWIDO foi a implementação da engine do jogo, que envolveu um conjunto básico de funcionalidades, mecanismo de criação e gerenciamento das partidas.

Ao entrar no jogo, o jogador é redirecionado à sala de espera onde aguarda até ser alocado, em uma nova partida. Durante esse período, conforme ilustrado na Figura B.1, o sistema recebe uma requisição para adicionar um novo jogador na fila de espera

[8]Apache License Version 2 http ://www.apache.org/licenses/LICENSE-2.0.html

[9]Desenvolvimento Ágil de Software http://pt.wikipedia.org/wiki/Desenvolvimento_ágil_de_ software

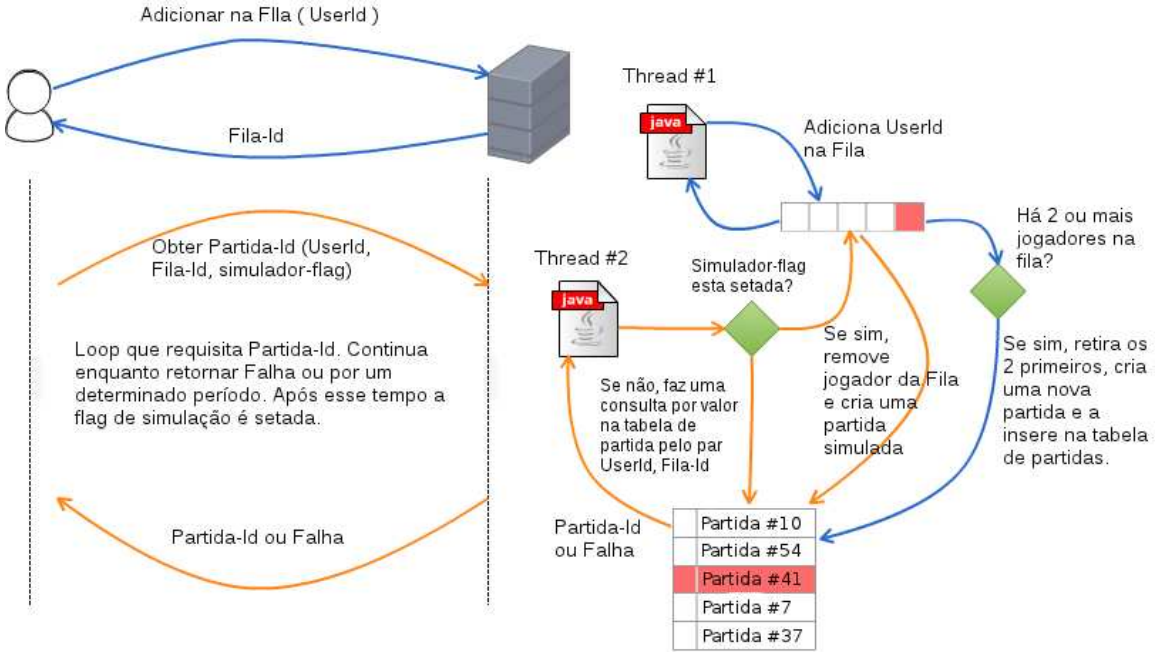

Figura B.1: Esquema do processo de alocar jogadores e criar partidas novas.

contendo um identificador (ID) do jogador. Então, é criado um objeto User contendo o UserId e o QueueId (um identificador gerado aleatoriamente que é usado para verificações de consistência) e o adiciona na fila de espera. Em seguida, é verificado se há mais de um jogador na fila. Se houver, o servidor retira os dois primeiros, cria uma nova partida e a adiciona na tabela de partidas ativas. Feito isso, retorna o QueueId para o jogador, que passa a requisitar o identificador da partida (MatchKey) em que foi alocado. Ao receber esse tipo de requisição, o sistema realiza uma busca na tabela de partidas ativas pelo par UsuerId QueueId. Se encontrar a partida, significa que o jogador foi alocado e então retorna o MatchKey, caso contrário, retorna uma mensagem de "Falha". Esse procedimento é repetido enquanto o servidor retornar "Falha" ou até um limite de tempo. Caso o limite seja atingido, a próxima requisição enviada ao servidor leva consigo a informação da necessidade de criar-se uma partida simulada. O servidor então retira o jogador da fila de espera e cria uma partida simulada, retornando o MatchKey.

Ao receber a reposta com o MatchKey o jogador é redirecionado para a tela de jogo. O sistema envia então uma requisição pelo primeiro round, passando o MatchKey como parâmetro. O servlet busca a partida na tabela e retorna o primeiro round que é exibido aos jogadores (Figura B.2).

O jogador escolhe a imagem que melhor representa o conceito para ele. Ao clicar sobre a imagem é enviada uma requisição de "Adicionar Escolha" contendo os dados da escolha feita por ele. O servlet busca a partida na tabela e adiciona a escolha recebida

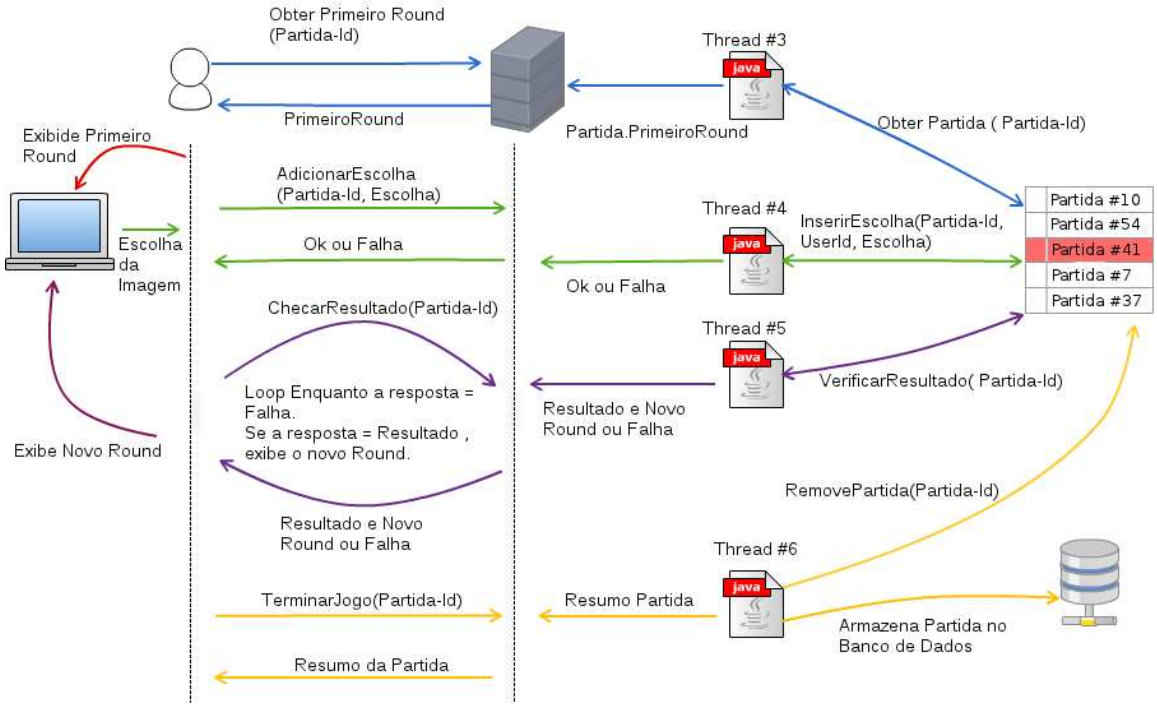

Figura B.2: Esquema do ciclo do jogo.

retornando uma mensagem de OK, ou de falha caso ocorra algum erro inesperado. Se a resposta for positiva, o jogador passa a enviar requisições solicitando sucessivamente o resultado do round, até que a resposta seja válida, ou seja, até que o outro jogador tenha adicionado sua escolha. O servlet verifica se os dois jogadores já escolheram; se não, retorna falha. Caso eles tenham feito a escolha, o servlet avalia as escolhas, atualiza a pontuação e retorna o resultado juntamente com os dados do próximo round. Ao receber essa resposta, o jogador reinicia o ciclo escolhendo uma imagem que melhor represente o conceito até o final do tempo de partida. A Figura B.2 ilustra essa sistemática.

Apêndice C

Autorizações para uso dos artigos

C.1 Correspondência com IADIS

10 de setembro de 2013 15:11

Subject: Permission Request
From: Romaniro <romaniro@gmail.com>
To: iadis org <secretariat@iadis.org>

Dear Prof. Pedro Isaias

I'm finishing my PhD and I would like to include the papers published at IADIS/WWW 2009 as a chapter in my thesis. The articles will be published in full, without changes (except text formatting, numbering of figures and tables, and format citations). The thesis will be available online in 2014.

Is it possible?

The papers is:
Romani, R. and Baranauskas, M.C.C. GWIDO - Games With Interaction Design Objective. In Proceedings of IADIS International Conference WWW/Internet 2009, pp. 351-358, IADIS Press, ISBN: 978-972-8924-93-5, 2009.

Thank you in advance.

Best regards
Roberto Romani

11 de setembro de 2013 12:20

Subject: Re: Permission Request
From: IADIS Secretariat <secretariat@iadis.org>
To: Romaniro <romaniro@gmail.com>

Dear Mr. Roberto,

After analysing your request we are informing that we grant the reprint permission of your paper . We only request that a clear mention is made to the fact that this is a reprint from a paper published in the Proceedings of the IADIS International Conference with a link to IADIS,
http://www.iadis.org .

Best regards,

Sandra Santos

IADIS Secretariat

C.2 Correspondência com SBC

10 de setembro de 2013 11:49

Subject: Solicitação para uso de artigos publicados em congressos da SBC
From: Roberto Romani <rromani@unicamp.br>
To: Sociedade Brasileira de Computação <sbc@sbc.org.br>

Para: Sociedade Brasileira de Computação (SBC),

No mês de Dezembro defenderei o Doutorado em Ciência da Computação no Instituto de Computação da Universidade Estadual de Campinas (IC/UNICAMP). Envio este e-mail com o intuito de solicitar autorização da SBC para incorporar artigos que foram publicados nos IHC 2012 e 2013 no corpo de minha Tese de Doutorado. Os artigos serão publicados na íntegra, sem alterações (com exceção da formatação do texto, numeração das figuras e tabelas, e formato de citações).
A tese será disponibilizada online na biblioteca digital da UNICAMP em 2014.

Os artigos são:
Helping Designers in Making Choices through Games. Romani, R. and Baranauskas, M.C.C. In Proceedings of the 11th Brazilian Symposium on Human Factors in Computing Systems (IHC '12), Brazilian Computer Society, Porto Alegre, Brazil, pp. 229-238, ISBN: 978-85-7669-262-1, 2012.

Putting GWIDO in use: promoting the culture of participation in the redesign of an educational application. Romani, R., Gutiérrez, J. E. and Baranauskas, M.C.C. In Proceedings of the 12th Brazilian Symposium on Human Factors in Computing Systems, Manaus, Amazonas, Brazil, 2013.

Conto com sua compreensão e agradeço a atenção,
Roberto Romani
IC-Unicamp

11 de setembro de 2013 11:51

Subject: Re: Solicitação para uso de artigos publicados em congressos da SBC
From: Sociedade Brasileira de Computação <sbc@sbc.org.br>
To: Roberto Romani <rromani@unicamp.br>
Cc: Eventos SBC <eventos@sbc.org.br>

Prezado Roberto,

Estou encaminhando sua solicitação para o setor de Eventos em cópia, por gentileza, aguarde o retorno.

Atenciosamente,

Tatiana Machado Carvalho Macedo
Secretaria
Sociedade Brasileira de Computação
Av. Bento Gonçalves, 9500 - Prédio 43412 - Sala 219
CEP: 91509-900 - Agronomia - Porto Alegre/RS
Tel.: +55 51 3308-6835 Fax: +55 51 3308-7142

12 de setembro de 2013 09:03

Subject: Re: Solicitação para uso de artigos publicados em congressos da SBC
From: SBC Eventos <eventos@sbc.org.br>
To: Roberto Romani <rromani@unicamp.br>, Cristiano <crismac@gmail.com>, Thais Castro <thais.helena@gmail.com>, Tayana Conte <tayanaconte@gmail.com>
Cc: Sociedade Brasileira de Computação <sbc@sbc.org.br>

Bom dia Sr. Roberto.

Estou encaminhando seu e-mail para os coordenadores gerais do IHC 2012 e 2013.
Favor aguardar retorno.

Prof. Cristiano Maciel e Profa. Tayana e Thais, favor verificar o e-mail do Sr. Roberto e informá-lo se é possível incorporar artigos que foram publicados nos IHC 2012 e 2013 no corpo de sua Tese de Doutorado.

Aguardamos retorno, obrigada!

Att.,

Pâmela Cilene Azevedo de Oliveira
Eventos
eventos@sbc.org.br
Sociedade Brasileira de Computação
Av. Bento Gonçalves, 9500 - Prédio 43412 - Sala 219
CEP: 91509-900 - Agronomia - Porto Alegre/RS
Tel.: +55 51 3308-6835 Fax: +55 51 3308-7142

12 de setembro de 2013 10:04

Subject: Re: Solicitação para uso de artigos publicados em congressos
da SBC
From: Cristiano Maciel <crismac@gmail.com>
To: "eventos@sbc.org.br" <eventos@sbc.org.br>
Cc: Roberto Romani <rromani@unicamp.br>, Thais Castro
    <thais.helena@gmail.com>,
    Tayana Conte <tayanaconte@gmail.com>,
    Sociedade Brasileira de Computação <sbc@sbc.org.br>

Prezados,

Acho que temos que seguir as normas da SBC e os copyrights assinados
pelos autores.
Pelo que entendo, o texto é do autor e ele pode usar, mas deve citar
a publicação de alguma forma.
A Diretoria de Publicação poderia opinar neste sentido?

Att.
Cristiano

Enviado via iPhone

12 de setembro de 2013 10:08

Subject: Re: Solicitação para uso de artigos publicados em congressos da SBC
From: SBC Eventos <eventos@sbc.org.br>
To: Cristiano Maciel <crismac@gmail.com>, "José Viterbo F." <viterbo@gmail.com>
Cc: Roberto Romani <rromani@unicamp.br>, Thais Castro <thais.helena@gmail.com>, Tayana Conte <tayanaconte@gmail.com>, Sociedade Brasileira de Computação <sbc@sbc.org.br>

Bom dia Prof. Cristiano, obrigada pelo retorno.

Estou encaminhando o e-mail para o Prof. José Viterbo, diretor das publicações da SBC.
Prof. Viterbo, favor nos informar seu parecer quanto ao questionamento do Sr. Roberto.

Aguardamos seu retorno, obrigada!

Att.,

Pâmela Cilene Azevedo de Oliveira
Eventos
eventos@sbc.org.br
Sociedade Brasileira de Computação
Av. Bento Gonçalves, 9500 - Prédio 43412 - Sala 219
CEP: 91509-900 - Agronomia - Porto Alegre/RS
Tel.: +55 51 3308-7744 Fax: +55 51 3308-7142

12 de setembro de 2013 12:55

Subject: Re: Solicitação para uso de artigos publicados em congressos
da SBC
From: José Viterbo F. <viterbo@gmail.com>
To: Roberto Romani <rromani@unicamp.br>
Cc: Cristiano Maciel <crismac@gmail.com>, Thais Castro
<thais.helena@gmail.com>, Tayana Conte <tayanaconte@gmail.com>,
Sociedade Brasileira de Computação <sbc@sbc.org.br>,
"eventos@sbc.org.br" <eventos@sbc.org.br>

Olá Roberto!

Concordo com o prof. Cristiano. É importante vc citar em sua tese,
ao apresentar cada artigo, que este foi originalmente publicado nos
anais do n-ésimo Simpósio de Fatores Humanos em Sistemas
Computacionais (IHC 201X).

[]'s

12 de setembro de 2013 13:43

Subject: Re: Solicitação para uso de artigos publicados em congressos da SBC
From: Roberto Romani <rromani@unicamp.br>
To: "José Viterbo F." <viterbo@gmail.com>
Cc: Roberto Romani <rromani@unicamp.br>, Cristiano Maciel <crismac@gmail.com>, Thais Castro <thais.helena@gmail.com>, Tayana Conte <tayanaconte@gmail.com>, Sociedade Brasileira de Computação <sbc@sbc.org.br>, "eventos@sbc.org.br" <eventos@sbc.org.br>

Prezados profs. José Viterbo, Cristiano, Thais e Tayana.

Certamente deixarei explícito na tese, para cada capítulo, qual foi o evento onde ele foi originalmente publicado informando a referência completa para cada um.

Muito obrigado pelo pronto retorno.

Saudações
Roberto Romani

C.3 Correspondência com ICEIS

10 de setembro de 2013 11:53

Subject: Permission Request
From: Romaniro <romaniro@gmail.com>
To: ICEIS Secretariat <iceis.secretariat@insticc.org>

Dear Prof. Vitor Pedrosa,

I'm finishing my PhD and I would like to include the papers published at ICEIS 2013 as a chapter in my thesis. The articles will be published in full, without changes (except text formatting, numbering of figures and tables, and format citations). The thesis will be available online in 2014.

Is it possible?

The papers is:

Romani, R. and Baranauskas, M.C.C. Exploring Human Computation and Social Computing to inform the Design Process. In Proceedings of ICEIS 2013. vol.3, pp. 44-51, INSTICC Press, ISBN: 978-989-8565-61-7, 2013.

Thank you in advance.

Best regards

Roberto Romani

26 de setembro de 2013 12:10

Subject: Re: Permission Request
From: ICEIS Secretariat <iceis.secretariat@insticc.org>
To: Romaniro <romaniro@gmail.com>

Dear Roberto Romani,

Thank you for your contact.

Yes, that is possible.

Best regards,
Vitor Pedrosa