Exploring Human Computation and Social Computing to Inform the Design Process

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Abstract: Although several standards, recommendations and guidelines have been used to assist designers in their tasks, much of the design choices still rely heavily on the designer's experience. In this work we argue that complex choices about interface elements (e.g. images, icons, sounds) could have the help of the users themselves to inform the designer´s choices. The paper situates the contribution in the intersection of the human computation and social computing fields, showing a preliminary survey of related work. Moreover, we illustrate the idea with an instantiation of an environment for designers, within the frontiers of human computation and social computing.

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 homogenous, 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 (University N.C.S, 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

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accomplish tasks that computers can not yet perform is defined as "Human Computation".

According Quinn and 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 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 considers 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 and 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 and 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 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 1 as a superset of social computing, human computation and crowdsourcing. This term is defined by 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.

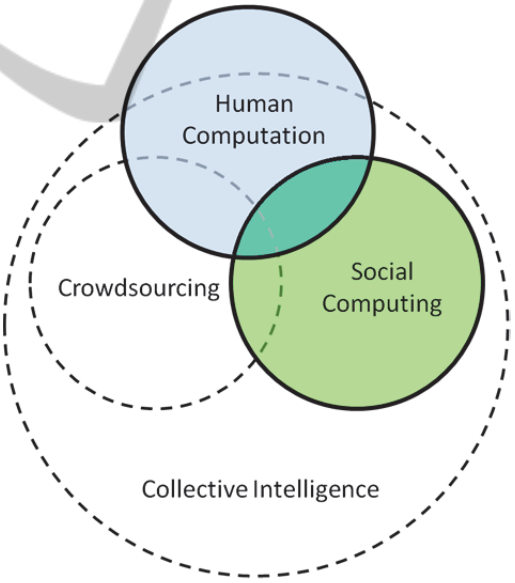

Figure 1: The intersection of Human Computation and Social Computing can be explored in benefit of interaction design process (adapted from Quinn and Bederson, 2011).

Although all research areas shown in Figure 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

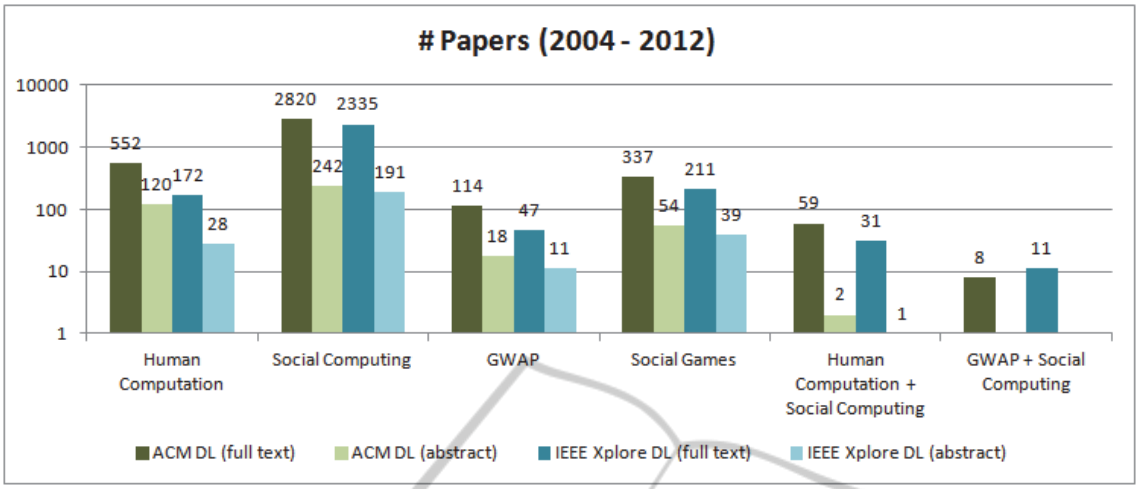

Figure 2: Number of papers published in conferences and journals.

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 (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 and Dabish, 2004). The ESP objective is to label images that are considered a complex task for computers. In this game, the 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 labelling 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).

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 and Whinston, 2007); (Quinn and 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.

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.

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

Table 1: GWAPS found in literature from 2004 to 2012.

Main Purpose	GWAPs	Human Skill
(7) Image tagging	ESP Game (Ahn and Dabbish, 2004)	Visual Recognition
	Phetch (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, 2011)	Visual Recognition
	ARTigo (Bry and 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, 2011)	Reading, Walking, Take Pictures
	SPLASH (Goh et al., 2011)	Reading, Writing and Visual Recognition
	Tsai & Yang game (Tsai and Yang, 2011)	Reading, Writing and Take Pictures
	Glob (Kothandapani et al., 2012)	Reading, Writing and Visual Recognition
(4) Collect common sense facts	Verbosity (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 and Anh, 2009)	Visual recognition
	Thumbs-Up (Dasdan et al., 2009)	Reading and interpretation
	Curator (Walsh and Golbeck, 2010)	Visual recognition
(3) Natural language processing	OnToGalaxy (Krause et al., 2010)	Reading and Writing
	Dil Cambazı (Gencer et al, 2012)	Reading
	Phrase Detectives (Chamberlain et al., 2012)	Reading and Interpretation
(3) Mapping users account across social network	GameMapping (Shehab et al., 2010)	Reading
	Pearl & Steyvers game (Pearl and Steyvers, 2010)	Reading and Interpretation
	GuessWho (Guy et al., 2011)	Reading and Writing
(3) Annotating videos	OntoTube (Siorpaes and Hepp, 2008)	Watching Videos and Interpretation
	Popvideo (Ahn et al, 2008)	Watching Videos and Interpretation
	Waisda (Oomen et al., 2010)	Watching Videos and Interpretation
(3) Creating ontologies or relationships for semantic web	OntoPronto (Siorpaes and Hepp, 2008)	Reading and Interpretation
	SpotTheLink (Thaler et al., 2010)	Reading and Interpretation
	LittleSearchGame (Šimko et al., 2011)	Reading and Writing
(2) Locates objects within images	Peekaboom (Ahn et al., 2006)	Visual Recognition
	P-HOG (Feng et al., 2012)	Visual Recognition
(2) Tagging music	Tag-a-Tune (Law & Anh, 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 and Baranauskas, 2009)	Visual Recognition and Interpretation
(1) Visual research and surveys	Sketcharoo (Hebecker and 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 (Kleek, et al., 2012)	Reading and Interpretation

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, 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 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.

A survey of GWAPs found in literature since 2004 considering the ESP game as the first proposed GWAP is presented in Table 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.

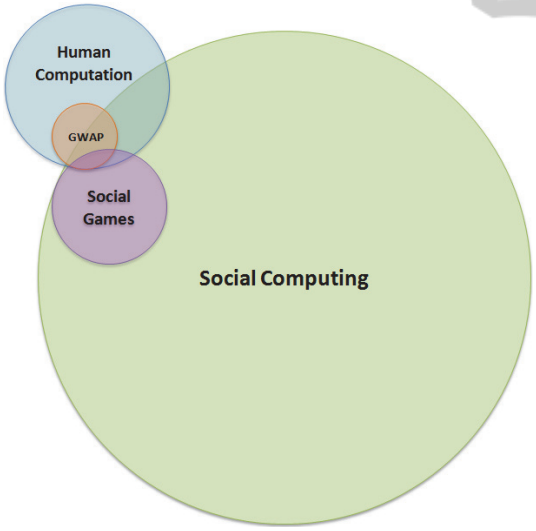

Figure 3: Schematic representation for the proportion of published articles and the intersection of fields.

Table 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.

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 and Baranauskas, 2009; 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 4). Then these games can be played by any users on the web (Romani and Baranauskas, 2012).

Figure 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.

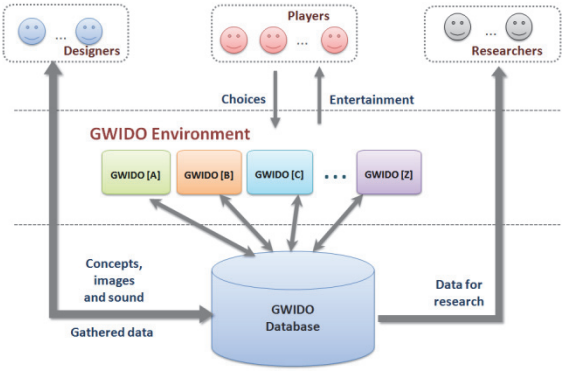

Figure 4: GWIDO environment architecture.

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 environment 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.

5 CONCLUSIONS

When the scope of an application is well-defined and the set of potential users is limited and homogenous, designers have been well instrumented in their practices. However, as the number of users increases augmenting their differences in terms of profiles, culture, social context, etc. the choices of designers become much more difficult. After a literature review on background work, this paper presented 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. Ongoing work involves case studies being conducted to evaluate the effectiveness of this approach, and further work involves a large scale test of the proposed environment.

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