

Universal Access to Interaction as Revealed by UAHCI Words

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Abstract. The analysis of publications created over time as journal articles and other media is important to emphasize the interests, identity and culture in a certain research area. This paper proposes an analysis on the content of the Universal Access in Human-Computer Interaction (UAHCI) conferences since 2007, based on information from the article titles. We were especially interested in knowing about changes in recent years related to user categories, the technologies used, and the processes associated with the systems engineering or with the human-computer interaction practices. Discussions are situated from the creation and observation of *tagclouds* formed with the data. As a contribution, we found what the words reveal about main trends of the area, the profile and the differences between the various editions of the conference, and also the gaps and potential for future research work toward accessibility and design for all.

Keywords: Universal Design, User and Context Diversity, Applications.

1 Introduction

Besides important to emphasize the interests, identity and culture in a certain research area over time [1], the analysis of institutional archives, as journal articles and other media, is important for readers, authors, publishers and advertisers to better and more objectively understand their field of interest. Moreover this kind of analysis may provide a glimpse of trends, modes of thought and the potential future for the area.

Accessibility has been considered a major concern of the Computing field, supposedly the most effective discipline for adapting the user interfaces to the varied needs of users, including those that are challenged to interact with computing systems despite their disadvantage physical condition [2].

The design of accessible software applications is considered very hard to achieve, due to several reasons: there is a proliferation of platforms through which people may interact with computer-based services and applications; modalities of interaction are being extended from the keyboard to include speech, gesture, touchscreen, etc.; the users also represent a wide diversity in their abilities usually not known to developers. Thus, it is difficult to anticipate every mode of interaction different people may use, providing accessibility to every platform and application. Moreover, as discussed by

Cerf [2], although general purpose tools to cope with specific human condition, such as screen readers for blind users or automatic caption for deaf users may be useful, no automatic adapting tool will make a poorly designed interface accessible.

Given the complexity of the problem, this work investigates the subject by getting a picture of the field, based on an analysis of the content of the Universal Access in Human-Computer Interaction (UAHCI) conferences since 2007. A set of 834 papers was published during this period: 246 in 2011, 248 in 2009, and 340 in 2007. Discussions are situated from the creation and observation of *tagclouds* formed with the article titles. We were especially interested in knowing about changes in recent years related to user categories, the technologies used, and the processes associated with the engineering of systems or with the human-computer interaction practices.

Therefore, this paper aims at providing a roadmap on work in the field, pointing out its trends, and showing the origin of major authors. This information may be helpful for researchers and practitioners who are starting work in the field, and even for experts who want to build on it. The paper is organized with a section situating the context of this research, followed by a description of the systematic review process; a section on the findings is followed by a categorization of results, analysis and discussion to finally conclude.

2 The Study Context, Representation and Method

The International Conference on Universal Access in Human-Computer Interaction is currently in its 7th edition, and has been part of the biannual HCI International, the International Conference on Human-Computer Interaction (now in its 15th edition). The HCII gathers other 9 related conferences addressing the thematic areas of Human-Computer Interaction, and Human Interface and the Management of Information. Thus, it represents a wide audience from academia, research institutes, industry and governmental agencies, and comprehensive content in the field, judged to be of high scientific quality. These papers address the latest research and development efforts and highlight the human aspects of design and use of computing systems.

The volumes analyzed in this work [6-8], correspond to the 4th, 5th and 6th editions of UAHCI, and contain papers in the thematic area of Universal Access in Human-Computer Interaction, addressing the following major topics: Diversity (116 papers in 2007, 77 in 2009 and 117 in 2011), Applications and Services (109 papers in 2007, 86 in 2009 and 72 in 2011), and Interaction, Design for All and eInclusion (115 papers in 2007, 85 papers in 2009 and 57 papers in 2011).

2.1 Data Representation

For an overview of the themes present in the conferences analyzed, we use the expressive power of representations known as *tagclouds* (tag clouds). A *tagcloud* is a visual representation of a set of words, typically tags (labels), which gained notoriety when it was used in social software sites such as "del.icio.us[®]" or "flicker[®]". Each

word is highlighted within the cloud according to its importance within the set of words, and gain enhancement through manipulation of visual characteristics, such as font size, color, weight, etc. [3]. For Rivadeneira et. al. [4], this format is useful for quickly providing the most prominent terms and relative importance of a specific word within the analyzed set. Also, it provides a general impression of the whole words set and the "essence" of the data represented. For example, in social software sites, the *tagclouds* can provide an impression about interests or expertise of a person.

Depending on the context in which they are used, Rivadeneira et. al. [4] suggest four different tasks that can be performed with *tagclouds*: search, navigation, impression formation or gisting, recognition or correspondence. Although *tagclouds* are less accurate and efficient in some specific cases than other forms of visualization, such as tables and wordlist, the *tagclouds* are advantageous to capture the essence of large amounts of descriptive information by presenting it succinctly [5]. This scenario of success motivated by the need of a summarized analysis of a large amount of data is one of the reasons for our choice of *tagclouds* as a representation in this work. For further analysis, tables and graphs were used (e.g. to show the relative frequency of words that stood out in a particular conference).

2.2 The Review Process

The review process is composed by 5 steps as briefly described. In the first step, all the papers published in all the conference editions were considered. A general-specific strategy was adopted to generate visualizations for the whole set of papers (general level) as well as for specific sub-topics (specific level). In the second step, the conferences were analyzed in isolation, starting from an overview and detailing their respective sections. In a similar way, an analysis was conducted to identify the most active authors in the field during the period, and the origin of the different contributions. In the fourth step, terms were organized into categories of interests: user profiles, technologies, and methods. In order to identify trends, we computed the frequency of appearance for some pre-defined terms. The result was organized by years, sections, and overall (considering the three conferences). Finally in the fifth step, all the information produced in the previous steps were crossed and analyzed. The analysis was supported by a tool that allows, among other things, to identify all papers that have some term of interest in their titles; the tool indicates the amount of papers that satisfy the query and the percentage that such amount represents of the total. An example of this search can be seen in Figure 1.

Observing the number of papers that use the term *Design* in their titles in Figure 1, the percentage remains almost constant in 2007 and 2009 with 15.88% and 14.92%, respectively, and increases in 2011 reaching 21.54%, suggesting an still increasing focus of interest.

3.1 Analysis by Topics

Treating Diversity. Diversity is in the realm of the universal access considerations regarding people's interaction with technology. The topic has been treated in the UAHCI in every edition of the conference: *Coping with Diversity* (in 2007), *Addressing Diversity* (in 2009), and *User and Context Diversities* (in 2011), with 116, 77 and 117 papers published, respectively.



Fig. 3. Tagclouds of terms used in the Diversity topic papers for 2007, 2009 and 2011

The tagclouds in Figure 3 reveal that the most salient word in this topic, in all the editions of the conference, is *Design* representing 30.17%, 24.68% and 27.35% respectively of the total of words (see also Figure 2). It is much more present than the word *Evaluation*, which represents respectively 4.3% in 2007, 5.19% in 2009 and 2.56% in 2011, suggesting more contributions towards design issues than to evaluation issues. Regarding other words reflecting stages of products lifecycle, *Development* appears in 6.90%, 1.30% and 5.13% respectively in 2007, 2009 and 2011, following the same pattern of the word *Evaluation*; while *Analysis* represents 3.45%, 0% and 3.42% respectively, and *Modeling* represents 0.83%, 2.60% and 0.85% of the words occurrences.

Regarding the user categories and human references addressed, the most salient words are: *User*, *Elderly*, *Older*, *Adults* (in 2007), *Cognitive*, *Elderly*, *Older* (in 2009) and *Older*, *User*, *People*, *Adults* (in 2011). The generic term *User* is still dominant, representing 19.83%, 20.78% and 17.95% of the words in 2007, 2009 and 2011 respectively, while the specific terms individually represent between 5 and 8%. Taking together, the *Older* and *Elderly* seem to be the most salient category of users addressed, representing 16.38%, 14.28% and 16.24% of the words. This category is followed by the *Adult*, with 5.17%, 1.30% and 6.84% of words occurrences in 2007, 2009 and 2011 respectively. It is worth mentioning the low occurrence of the words *Children* and *Child*, the last one represented by 1.72%, 1.30% and 0.85% of the words in each edition of the Conference: 2007, 2009, 2011, while the words *Teen* and *Teenager* appear only in 2011, representing 0.85% of the words. The generic term *Disabled* represents 3.45%, 1.30% and 1.71% respectively in the 2007, 2009 and 2011 editions, similarly to the more salient specific disabilities: *Blind* appears in 3.45%, 0% and 1.71% in 2007, 2009 and 2011 respectively, while *Deaf* appears 0%, 2.60%, 0%.

Still regarding the target users' considerations, it seems to have a smooth change in focuses along the editions of the Conference, reflected in the appearance and disappearing of some specific words. The focus seems to go from *biometric* (3.45%,

0%, 0.85%) and *authentication* (5.17%, 0%, 0%) technologies for the blind and disabled in 2007, to *cognitive* (5.7%, 11.69%, 2.56%), *mental* (2.59%, 5.19, 1.71%) impairments (e.g. *dementia* 0%, 5.19%, 0%) in 2009, to aspects related to *affective* experience (0%, 0%, 4,27%), and *culture-specific* (0%, 1.30%, 3.42%) issues in 2011.

Regarding context diversity, from the generic *Home* (5.17%, 1.30%, 1.71%), specific domestic environments start to appear along the Conference editions, e.g. *Living* (0%, 2,60%, 4,27%) and *Kitchen* (0%, 0%, 1.71%).

Applications. *Applications and Services* is the topic maintained in the three editions of the Conference, with 109, 86 and 72 contribution papers, respectively.



Fig. 4. Tagclouds in the Applications and Services topic papers for 2007, 2009 and 2011

The tagclouds of Figure 4 reveal that *Accessibility* and *Web* are the two most frequent words in 2007 and 2009 contributions, showing a decrease in 2011: *Accessibility* represents 20.18%, 17.44%, and 6.94% of the words in this topic, respectively, while *Web* represents 14.68%, 20.93% and 6.94%. The most frequent word in the third edition of the Conference is *System*, growing from 9.17% in 2007 to 13.95% in 2009 and 18.06 in 2011. It is worth noting that the *Usability* classical word present in the titles of contributions represents 3.67%, 3.49% in 2007, 2009 respectively and disappeared (0%) in 2011.

Learning and Education seem to be the main focuses of applications and services in all considered editions of the Conference. *Learning* and *Education*, taken jointly represent 23.86%, 12.8% and 20.83% of the words in the contribution titles of this topic in 2007, 2009 and 2011 respectively. Nevertheless, *e-Learning* has shown a decrease represented by 11.01% of appearance in 2007, to 3.49% in 2009 and 1.39% in 2011. *Management* has also shown a place, except for 2009, with 5.50% and 6.94% of the words in 2007 and in 2009.

The *Web* seems to be the main platform addressed, besides being one of the two most frequent words, representing 14.68%, 20.93% and 6.94% of the words. Nevertheless, other words suggest trends such as *Mobile*, with increasing appearance: 0.92%, 3.49% and 4.17% in 2007, 2009 and 2011 respectively, although the word *Phone* does not appear at all.

Regarding the Design-Evaluation balance, the data show more salience for *Evaluation* in 2007 (11.01% of the words), decreasing in the last two editions: 3.49% in 2009 and 5.56% in 2011, while *Design* remains constant around 10% of the words

(10.09%, 10.47% and 9.72% in 2007, 2009 and 2011 respectively). Also, studies seem to be the predominant type of contributions in this topic, with *Study* appearing in 2.75% , 9.30% and 8.33% of the words in 2007, 2009 and 2011, respectively.

Interaction, Design for All, eInclusion. In this work we are analysing Interaction-related words as they appear in the following topics of the three last editions of the Conference: *Ambient Interaction* in the 2007 edition, *Intelligent and Ubiquitous Interaction Environments* in the 2009 edition and *Design for All and eInclusion* in the 2011 edition. The tagclouds for these topics are illustrated in Figure 5.



Fig. 5. Tagclouds in the Interaction, Design for All and eInclusion topic for 2007, 2009, 2011

The 2007 and 2009 tagclouds are quite similar in the words they salient, changing place between the first and second most frequent words. *Ambient*, *Environment*, *Mobile*, *Interface* and *Interaction* are around 10% and 19% of the words in both editions of the Conference and are less explicit in the 2011 edition, ranging from zero presence, e.g. for *Mobile*, to 1.75% for *Ambient* and 5.26% for *Environment* and *Interaction*, respectively, to 12.28% for *Interface*.

Words representing categories of interaction in the 2007, 2009 and 2011 editions are represented by *Adaptive* (4.35%, 4.71% and 8.77% respectively), *Intelligent* (4.35%, 4.71%, 1.75% respectively), *Visual* (4.35%, 2.35%, 8.77% respectively), *Multimodal* (6.09%, 2.35%, 7.02% respectively), among the most recurrent.

Except for the word *Interface*, which maintain a high salience in the three editions of the Conference, the 2011 edition topic data suggest a shift in focus from the environment/ambient interaction to the higher level concepts of Design for All and eInclusion, adding to some words in common (e.g. *Adaptive*, *Visual*, *Multimodal*), issues such as [user] *experience* (0% in 2007 to 5.26% in 2011), [public] *policy* (0% in 2007 and 2009 to 3.51 % in 2011), and *cultural* issues (0.87% in 2007 to 3.51% in 2011), as well as other devices (e.g. *TV* from 0% in 2007 and 2009 to 3.51% in 2011) suggesting demands for new ways of interacting.

3.2 The UAHCI Worldwide Extent

In this work, we extracted the full list of authors of papers from 2007 to 2011. This list included a total of 2024 authors and then we did the data analysis including only those authors who published two or more papers, so we were left with a total of 340 authors. For each of these, we established the country and institution that they represent. We found that those authors come from 30 countries, 200 institutions and 834 papers contributed to the themes of UAHCI from 2007-2011. This information is resumed as follows.

Devices and platforms still appear in generic terms: *Mobile* represents 6.59% or 55 papers (more salient in the Interaction topic), and *Web* represents 8.15% or 68 papers (more salient in the Applications topic). Application domains have a clear focus on *Education* and *Learning*, which together represent 8.39% or 70 papers; the *Health* domain is still present in 2.16% or 18 papers, with an important growth in 2011.

The general results also show that the social aspects of system design and use, typical of the contemporary Web applications, although experiencing a growth in the last edition of the Conference, are not still so prominent (*Social* is present in 1.80% or 15 papers). Moreover, the trends of the HCI domain for future towards elements of affective, emotional, motivational issues, as discussed by [9] are poorly addressed (*Affective* appears in 0.6% or 5 papers, *Emotional* and *Motivation* appear in 0.24% or 2 papers, each), representing open opportunities in the field. Also, It is worth noting the timid appearance of *Value* (0.24% or 2 papers), and *Aesthetics*, which is not present.

The worldwide distribution of the authors and their institutions show a predominance of contributions coming from Europe. This fact might suggest the data is reflecting, in some way, the European scenario of needs regarding access to technology. This also leads us to wonder how different the data could be whether situated in different scenarios, as for example of developing countries, where other challenges have to be faced regarding eInclusion, for example illiteracy and social barriers.

4 Conclusion

The design of software applications considering the varied needs of users, including those that are challenged to interact with computing systems despite their physical, psychological or social conditions is considered very hard to achieve. The HCI field has accumulated knowledge to cope with the challenges of designing interactive devices. Getting an overview of the main issues that have been addressed in recent years in the field is a way to identify lacking issues and new research opportunities.

This paper shed light on the main focuses of research addressed by the last three editions of the UAHCI Conference and the origin of the contributions. Results show the wide extent of the Conference, having contributions from 2014 authors coming from 30 countries, 200 institutions. Nevertheless, European countries lead the highest average production by author among countries with more than 15 authors. Roughly, *Design* is the most frequent word in the contributions, the *Older*, *Elderly* and *Adult* are the most addressed categories of target users, the *Mobile* and the *Web* are the most present platforms for interaction, although as generic references. There is few allusion to the social issues typical of contemporary Web applications, such as those associated to social software and the related concepts such as values, aesthetics, collaboration, participation, signaling important subjects still open to research in the field.

The analysis used *tagclouds* as a way to get the accentuation of subjects being discussed in the different topics of the Conference. The results obtained also indicate that the use of *tagclouds* provided a quick and simultaneously comprehensive overview of the data, considering the volume analyzed. Although paper titles usually are representative of their content, a possible refinement in the study could incorporate keywords and the abstracts, for further analysis. The tool developed for supporting this work also enables further work, to analyze specific classes of contributions.

Acknowledgements. This work was partially funded by CNPq, as part of EcoWeb Project #560044/2010-0. We also thank the University of Quindío and CAPES.

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