

Web Collaboration Motivated by Colors Emotionally based on Common Sense

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Abstract— Quality of Life is one of the main concerns nowadays for everybody. Also it is considered that is necessary to save time, space, energy, etc, in order to guarantee comfort, family health links and good job results. Work at home is becoming more common, especially through the Web. Collaborative and Participatory work via Web tends to increase due to teams of people's needs in accomplishing tasks separated by distance and time, which demands more effort and stronger commitment from each person. In this context, it must be considered cultural differences, which interfere with the performance of each individual and either promote or deny the communication intended for the group. Especially nowadays with many computer based environments for supporting such tasks, the culture factor is becoming imperative to reach teams' success. Differences among people make difficult the definition of universal parameters that organizations can use to motivate people. There is always a subjective component in motivation that is complex, related to culture and individual values. Color, learning style and the use of a certain vocabulary vary according to the culture. This paper aims to discuss a multidisciplinary analysis about colors and stimuli in computer environment using Common Sense knowledge, considering the cultural associations people make with colors, showing how it can motivate users to Web collaboration using color symbolically built in the culture.

Keywords— Web Project, Colors, Emotions, Common sense.

I. INTRODUCTION

With globalization and the need for fast communication without fixed places and time, the use of the Internet and Web tends to become more and more usual, creating the easiness of exchange information and users collaboration via Web. New technologies have changed the ways in which people interact and collaborate in a distance. The users can be connected to the net and practice new ways of collaborative work [17]. Many people can collaborate with remote peers via Internet. According to Schümmer *et al.* [17], in professional work life or even in other kinds of organizations like schools or non-governmental organizations, several companies collaborate via distributed work groups, employees or students or even volunteers in distant parts of a virtual organization can form dynamic ad-hoc teams in some production processes, and people participate in virtual communities to increase their professional capabilities (continuous learning). This process is also visible in private life where computer users increasingly participate in communities to make their lives easier or more interesting. As a result of such situation, the tendency is that

more and more Web applications are designed to be used by more than one user in a collaborative way, such as: multi-player games, learning management systems, wikis, chats and community systems, etc.

Consequently, it is necessary a more contextualized approach to the Web environment interaction development model to reach such level of collaboration. The main goal of any project is to motivate the use of such application. The developers, of collaborative work web applications, try to understand what motivates the users to engage to job and with this information they create a virtual environment which makes possible the individual satisfaction working with the applications in a productive way. For such satisfaction, one of the main subjects chosen in the research presented here is the application of colors on the Web project, essential for visual communication, that can reinforce or not the communicative intention. Colors can help the developers to highlight important points (improving usability), as well as facilitate the content comprehension (improving accessibility). In cultural context, colors are considered a factor for the quality of those systems. It is important to study and understand which are the values aggregated to the colors, once those values can be interpreted, and so that can vary from each culture [18].

The promotion of universal access to information comes from respect to culture, facilitating through the colors and their meanings, the access to information and contextualized knowledge. This work offers a multidisciplinary analysis about colors, symbolically constructed in culture, to develop Web applications that encourage collaborative work. It is important remember that this work consider people with normal vision, i.e. people that see the colors. The significance of color is an issue explored here considering the cultural context, represented by peoples' common sense knowledge from OMCS-Br Project knowledge base [2].

II. MOTIVATION FOR THE ENGAGEMENT IN ACTIVITIES

To promote the users' engagement in the computer-mediated collaborative activity, the interface design should contain elements that are intuitive, useful and familiar to each user [14]. Sun [20] quotes examples to demonstrate the importance of cultural aspects in interaction project, such as: interface elements (the Brazilian users like vibrant colors and pages with many figures, and the Germans prefer organized links in alphabetical order); the cultural symbols (the Brazilians

and Chinese feel comfortable when they see figures on their cultures - sugarloaf and lotus flower); and the way of showing cultural symbols (the Germans prefer textual components, whereas the Brazilians and Chinese prefer colorful visual components). Even considering the importance of those subjects, developers still have difficulties in obtaining support to their research regarding to the interaction projected according to the users' culture. As shown in Figure 1, according to Salgado [16], Maslow has structured the human needs in a hierarchy, in order to satisfy one level (self-actualization), it is required to satisfy all the previous ones and the most basic ones should be attended first. However, according to Murray *apud* Novaes [12], need factors can act in a disordered way, according to each individual, and can be achieved simultaneously, without a rigid hierarchy.

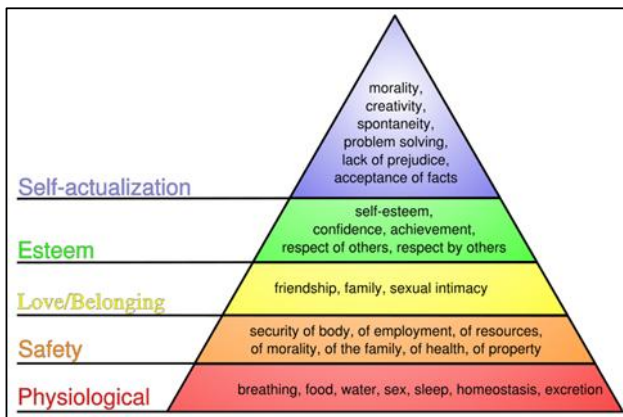


Figure 1. Maslow's need hierarchy [11]

Bueno [4] says that human motivation has been one of the biggest challenges in organizational administration for many psychologists, teachers and executives. Some researches and theories have been elaborated and tried to explain the operation of this apparently mysterious or even unknown force that leads people to act in order to reach their objectives. It is important to remind that the differences among people make difficult an universal parameters definition that organizations can use to motivate people in the same conditions. There is always a subjective component in motivation that is complex, related to culture and individual values. For that reason this study taken into consideration the common sense knowledge base of OMCS-Br Project [2] to try to smooth that inequality of conditions, as well as to provide solutions to assist each individual's cultural values involved in the collaborative task, considering his/her community knowledge.

III. COMMON SENSE KNOWLEDGE

OMCS-Br Project [2] explores the Web as a way for collaboratively constructing a common sense knowledge base, counting on contributions of Brazilian volunteers' statements. Common Sense is defined here as a group of facts known by most people, "including a wide part of human experiences, knowledge on special, physical, social, temporary and psychological aspects involving daily experiences of humans" [8] and that express a certain group's culture [2]. OMCS-Br Project can contribute to overcome difficulties that many

developers face to obtain support from researches regarding the target users' culture designed for collaborative environment.

Currently, this project is collecting common sense knowledge on colors, emotions, action and objects [6] as shown on Table I. According to templates in Table I, it is observed that there are three tables in the database: to stores complete sentences entered by the site (table entries), for emotions (table emotion), and for names of the colors (table colors) being the images of colors generated randomly in a HTML sequence. The capital letters words are typed by the users and later used to feedback other templates (the underlined words) and the words in italic are generated randomly. An example of that feedback is presented in Figure 2 [6]. In the example, the template 6 from Table I is being used to collect emotions that serve as feedback for the template 7. Figure 2 shows how such knowledge collected as Common Sense is used in the feedback process. To learn how these data are organized to be used, next section deals with color classification.

TABLE I. TEMPLATES OF COMMON SENSE KNOWLEDGE COLLECTING RELATED THE COLORS, EMOTIONS AND OBJECTS

1	(object) reminds me the color (COLOR NAME)
2	(image color) makes me wish (ACTION)
3	(image color) reminds me a(n) (OBJECT)
4	(color name) reminds me a(n) (OBJECT)
5	(color name) makes me wish (ACTION)
6	Color (image color) makes me feel (EMOTION)
7	When I am (emotion) I remember the color (COLOR NAME)
8	Color (image color) reminds me the color (COLOR NAME)

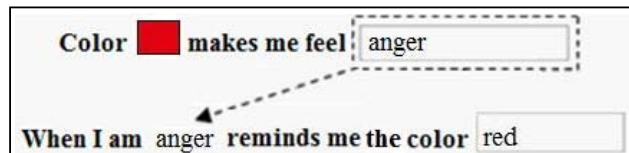


Figure 2. Example of feedback in Templates

IV. COLOR CLASSIFICATION

The human eye is able to discriminate thousands different colors, but the language gives a limited number of basic terms of color. Every language that has words for colors, uses from two to eleven basic terms, and the colors not included in these terms, are considered variant colors [3].

The emergence of the basic terms for color follows a natural logic. This logic is composed by several evolutive trends, in particular: 1) from general to specific, i.e., from light/dark distinction to tone discrimination, 2) from the more evident the less - for example, red before other tones, 3) from the simple to the complex, i.e., from the isolated colors for mixed ones [15]. The basic terms for color are the result of social use of color not only to mean objective differences of nature, but also communicate significant distinctions of culture.

This work uses the classification suggested by Berlin and Kay [3]. The eleven colors spoken by Brazilians are: yellow, blue, white, gray, orange, brown, black, pink, purple, green and red. As shown in Table I, template 8 on common sense knowledge collection site has been developed to confirm, through common sense, that people express themselves using a few names of colors when they see various shades of them. Some data already collected by template 8 can be seen in Figure 3:































Color  reminds me the color yellow	Color  reminds me the color red
Color  reminds me the color yellow	Color  reminds me the color red
Color  reminds me the color yellow	Color  reminds me the color red
Color  reminds me the color yellow	Color  reminds me the color red
Color  reminds me the color yellow	Color  reminds me the color red
Color  reminds me the color yellow	Color  reminds me the color red
Color  reminds me the color yellow	Color  reminds me the color red
Color  reminds me the color yellow	Color  reminds me the color red
Color  reminds me the color green	Color  reminds me the color blue
Color  reminds me the color green	Color  reminds me the color blue
Color  reminds me the color green	Color  reminds me the color blue
Color  reminds me the color green	Color  reminds me the color blue
Color  reminds me the color green	Color  reminds me the color blue
Color  reminds me the color green	Color  reminds me the color blue
Color  reminds me the color green	Color  reminds me the color blue

Figure 3. Example of color name collected by the OMCS-Br

V. Color and Emotions

It is known that the light of each one of the colors, starting from the moment that it is reflected in the eyes and processed in the mind, can affect the center of the emotions. However, each person answers to the color in a particular way. People tend to be attracted to some colors because of some decisive factors, such as, personality, incidental conditions of life or inner desires and deeper or unconscious mental processes. Nevertheless, Berlin and Kay [3] report that the personal choices are conditioned to the community culture background what is considered in our research. Therefore, it is important to stand out that in any culture, colors can transmit good or bad meanings. Some authors [14][18][7] mention some of those meanings for colors in the western culture:

- **Yellow:** color for light and heat, for sun and summer, it is associated to prosperity and wealth, and transmits hope;
- **Blue:** favorite color of more than half of the western population, color of water, sky and sea, it transmits trust, calm and harmony;
- **White:** color of lightness and cleaning, color of snow, means purity, peace, easiness or kindness;
- **Orange:** is associated to enthusiasm, and can be a sign of health and dynamism;
- **Black:** color of authority, renouncement and religion, sadness, mourning, protest, melancholy, elegance and modernity;
- **Green:** color of fortune and money, nature, ecology, hope and it means safety, protection and coolness;

- **Red:** color of danger, prohibition, love and passion; it is also associated to heat, excitement and willing to act.



According to Dias *et al.* [6] from that list of meanings, we notice the need of integrating colors and emotions to support design decisions of collaborative computer environments.

Silveira *et al.* [18] talking about colors guarantees a debate full of controversies and a lot of discussion, because it is a complex study and basically interdisciplinary. For Pastoreau [14], it is possible to identify characteristics attributed to the culture that the individual is inserted through the study of symbology of colors, what helps the Web designer take advantage of that knowledge, besides noticing the collective meaning of colors in that community.

For Silveira *et al.* [19], only the use of intuition to define colors of the projects in the Web most of the time does not work. Intuition should be used added to a lot of information and reasoning to get harmony, so that the designer does not take the risk of driving the project to a no-communication between user and the system and, consequently, among the collaborative team work. To decrease the chance of make a mistake, we propose to analyze the common sense knowledge from a certain community and the relation among color, emotions, actions and objects.

From the OMCS-Br Project, it can be collected examples for colors related to the culture of a certain community. Table II show some sentences people registered. According to the samples in Table II, blue color is related to water by most people, which can be inferred that when a Web designer will projects a site to a enterprise to work collaboratively using blue color most of the team members will tend to think in something related to water, relaxing, and comfort due to the blue tone of the site, reflecting on the individual motivation and the group productivity. However, the emotions wakened from that memory cannot be inferred by people that are not specialist in psychology, anthropology or similar areas.

TABLE II. EXAMPLES OF SENTENCES COLLECTED BY OMCS-BR PROJECT

1	sky reminds me the color blue
2	 makes me wish dipping in the pool
3	 reminds me a(n) ocean
4	Dark blue reminds me a(n) ocean
5	blue makes me wish swimming

According to Soto [19], emotions offer and transcend important information about people. If taken into account, emotions can change behavior, performance, aiming at modifying situations around us. In addition, Soto points out that those emotions can be intelligently and carefully stimulated to reach the peoples' goals, so they can accomplish the activities.

The analysis of emotions collected by the site considering the collaborators' common sense aims to encourage people to work through the colors on the collaborative Web application design, considering the meanings and feelings that it brings attached to it. An emotion-producer stimulus originates an emotional answer (inner reaction) that acts as motivator

stimulus that takes to an emotion expression which is the emotional behavior (external reaction) (Figure 4). Emotion is the emotional behavior or answer facing one emotional state which turns into incentive. The function of emotion is to provide to the organism the level of arousal (pleasure or displeasure experience) according to the emission of the most appropriated answer to each specific situation. Emotion predisposes people: (I) to get what can be useful to satisfy the needs; (II) to avoid what can be opposed to that satisfaction [19].

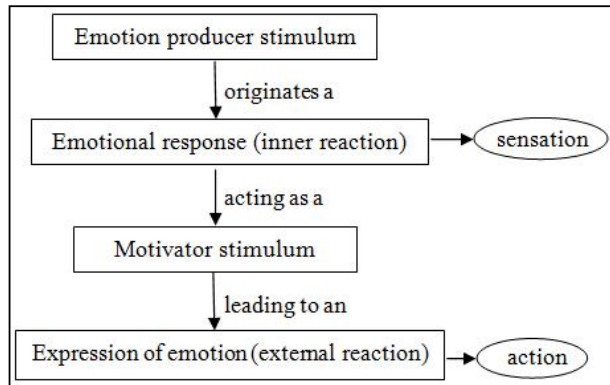


Figure 4. Reaction chain to emotion produces stimulus [19]

Emotion is an important issue in human behavior and it assumes significant role in the motivational process. Besides, that emotion requires great level of arousal, which is the product of subsequent physiological changes to the activation of the nervous system.

The OMCS-Br Project also collects common sense knowledge related to emotion. People tend to relate an emotion when seeing a certain color and when speaking about a color they remember to feel a certain emotion. Some examples can be seen in Table III.

TABLE III. EXAMPLES OF COLOR AND EMOTIONS ON OMCS-BR PROJECT

1	Color ■ makes me feel JOY FUL
2	Color ■ makes me feel CALM
3	Color ■ makes me feel QUIET
4	Color ■ makes me feel JOY FUL
5	Color ■ makes me feel HAPPINESS
6	When I am <u>passionate</u> I remember the color RED
7	When I am <u>happy</u> I remember the color YELLOW
8	When I am <u>aggressive</u> I remember the color RED
9	When I am <u>joy ful</u> I remember the color BLUE
10	When I am <u>sleepy</u> I remember the color BLUE

As it is in Table III, there are examples of two templates relating emotions and colors. From example 1 to 5, the users see a certain color presented randomly and tell their emotions. From 6 to 10 the user come across an emotion and says the color that (s)he relates to it.

In Table III is observed that the blue colors can be related to several characteristics such as: to be cheerful, calm, depressed; while the red colors are related to passion or aggressiveness. However a wide study on the common sense knowledge base is being developed to notice the cultural association of colors and emotions, not only personal choices.

It is known that motivation is essential for running organizations. No matter the amount of resources or activities is provided, these cannot be used if people are neither motivated nor engaged in their tasks [12]. The intention here is to give some support to motivate people to get engaged into their Web-based tasks

VI. CLASSIFYING EMOTIONS CONSIDERING COLORS FROM COMMON SENSE

The OMCS-Br Project is collecting common sense knowledge on colors and emotions through of two templates, as shown on Table III in Section V. Nowadays, there are more two thousand facts. These facts were organized in the classification suggested by Berlin and Kay [3], as shown in Section IV. This organization can be seen in Figure 5.

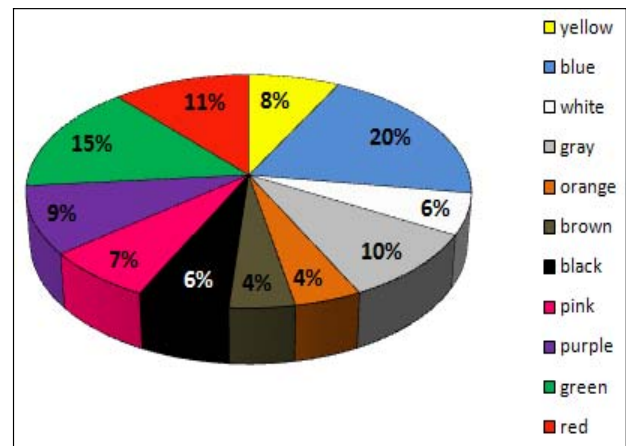


Figure 5. Templates of common sense knowledge collecting related the color and emotions

Most people remember the blue color, followed by green and so on; this fact is illustrated in Figure 5. This feature is because the collection was made in Brazil and according Pastoreau [14], blue is the first favorite color of over half the population West, second is green and third is red. Additionally, blue is favorite color of the people calm, secure, balanced and fair.

To analyze the relationship between colors and emotions was necessary first to classify the emotions in the common sense. For this, it was used an emotion classification created by Parrot [13]. Parrot says that there are six primary emotions, such as: love, joy, surprise, anger, sadness and fear. With the help of a psychologist, emotions of common sense were classified within emotions defined by Parrot, as illustrated in Table IV.

TABLE IV. EMOTIONS OF COMMON SENSE CLASSIFICATION

Love	Affection	Parrot Classification: Adoration, affection, Love, fondness, liking, attraction, caring, tenderness, compassion, sentimentality Common sense Classification: nested, warm, loved, friendly, loving, attentive, attracted, affectionate, with love to give, with tenderness, comfort, with tenderness, enamored, gentle, safe, romantic, sentimental, sympathetic
	Lust	Parrot Classification: Arousal, desire, lust, passion, infatuation Common sense Classification: crazy, passionate, fascinating, smart, horny, seductive, sensual
	Longing	Parrot Classification: Longing Common sense Classification: with thirst, hot, with heat
Fear	Horror	Parrot Classification: alarm, shock, fear, fright, horror, terror, panic, hysteria, mortification Common sense Classification: alarm, frightened, scared, panic, danger, hysteria
	Nervous	Parrot Classification: anxiety, nervousness, tenseness, uneasiness, apprehension, worry, distress, dread Common sense Classification: distressed, anxious, apprehensive, angry, uncomfortable, upset, nervous, alert, tense

It was realized an analysis with each color represented in Figure 5, after the classification of emotions in the common sense. This work uses the red color to exemplify this. The red color is being used because it has one of the largest data collected by OMCS-Br Project.

When people remember the red, they associate to the primary emotions in the following order: joy, fear, love, anger, sadness and surprise (Figure 6). The information obtained in the common sense is very valid and important when compared to some definitions of red to some authors, such as Pastoreau [14], Silveira *et al.* [18] and Guimaraes [7] whom say that the red awakens danger and prohibition (fear), love and passion (love); it is also associated to heat, excitement and willing to act (joy).

Additionally, these authors say that red color represents the color of people with magnetism and great mental strength or vital organ. They are dynamic, unstable, enterprising and sometimes even violent in extreme cases. The use of the red color is indicated to environments that have the objective of interaction between people.

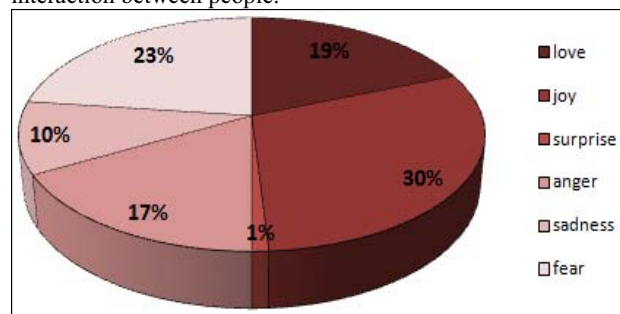


Figure 6. Primary Emotion Classification of common sense knowledge

After understanding the general classification of the red, it is possible to see why such emotions prevailed more than others. This is explained from secondary emotions exemplified in Figure 7.

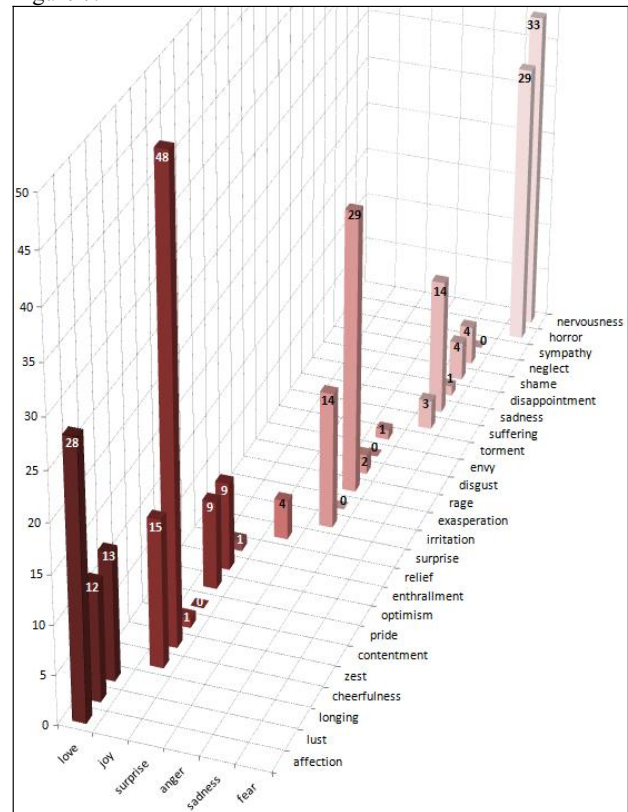


Figure 7. Secondary Emotion Classification of common sense knowledge

Figure 7 illustrates the secondary emotion "zest", it was most cited for the primary emotion "joy". After that, the secondary emotions "and nervousness horror" were also cited for the primary emotion "fear". Finally, the secondary emotion "affection" was the most remembered of the primary emotion "love".

This information was collected on the colors and emotions. The next section talks about the relationship between colors, emotions, objects and actions that is currently being done in the project.

VII. CLASSIFICATING EMOTIONS, OBJECTS AND ACTIONS CONSIDERING COLORS FROM COMMON SENSE

To analyze the information collected by these templates, it is being done a classification of emotions, actions and objects. Figure 5 shows an example with the red color, where the square shows the color to be analyzed. The list of emotions that red evokes in people is shown in the left ellipse. In the back ellipse, the actions that people are willing to perform when they see the red color. The right ellipse brings the objects related to the red color. See http://www.dc.ufscar.br/~ana_dias/piramide.html for all colors analyzed.

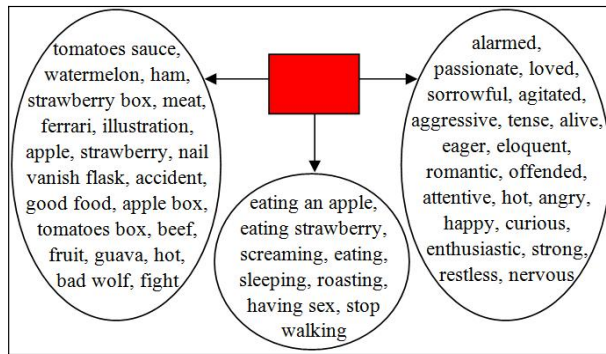


Figure 8. Red color associated emotions, actions and objects

VIII. CONCLUSIONS

According to the hypothesis explored in this work, individual motivation and participation in work via Web are encouraged by the application of colors in the computing environment design. Therefore, its success is achieved when other variables are considered in this application of color, exploring the cultural meanings that evoke stimulus and action. This application of colors can determine the individual's degree of engagement and participation. We believe that information comprehension happens when culture is respected, facilitating, through colors and their meanings, the access to information and contextualized knowledge. For these considerations happen, assessments are being made from the common sense knowledge base of potential users to collaborative Web environments. In Web application context, it is intended to investigate the significance of color according to peoples' culture, in order to understand how to provide adequate stimulus to visitors of collaborative sites, considering their goals and motivation.

In the future, from the analysis of colors collected in common sense, this work intends to formalize Motivational Patterns, which describe social processes (intrinsic motivation) and may propose either changes or extensions to secondary tech support as it is traditional in design patterns (extrinsic motivations) [10]. There are some formalized Motivational Patterns [5] [9] [10] [17]. None of these papers, however, explore the question about the use of color in Web design for collaboration promotion, the need to consider issues involving the users' culture in collaborative work sites, as well as the correlation between these two elements - color and culture - to promote universal access to information.

Additionally, this work will extend to people with some problems, such as: color-blind or others disabilities. Another way to search is to establish the correlation between Motivational Patterns, characteristic to HCI area, and Organizational Patterns as those presented by Ambler [1], from Software Engineering area, making an increasingly close association between these two computer areas in order to achieve more effective results in collaborative computer system design.

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REFERENCES

- [1] Ambler, S. W., 1998. *Process Patterns: Building Large-Scale Systems Using Object Technology*. Cambridge University Press, 582p. ISBN: 0521645689.
- [2] Anacleto, J.; Lieberman, H.; Tsutsumi, M.; Neris, V.; Carvalho, A.; Espinosa, J.; Zem-Mascarenhas, S.; Godoi, M. "Can common sense uncover cultural differences in computer applications?" In: BRAMER, M.(Org.). *Artificial intelligence in theory and practice - WCC*. Springer-Verlag, v.217 (2006), p1-10.
- [3] Berlin, B; Kay, P. *Basic color terms: their universality and evolution*. Berkeley: University of California Press, 1969, 210p.
- [4] Bueno, M. "As Teorias de Motivação Humana e sua Contribuição para a Empresa Humanizada: um tributo a Maslow". CESUC, IV, n6,2007,25p.
- [5] Clear, T.; Kassabova, D., 2005. "Motivational Patterns in Virtual Team Collaboration". *Australian Computing Education Conference*. Newcastle, Australia, v.2, 8p.
- [6] Dias, A.; Anacleto J.; Silveira, L.; Penteado, R. *Formalizing Motivational Patterns on colors and their cultural meanings for developing Web applications*. ACM SAC2009, Hawaii, USA /tobepublished/, 2009.
- [7] Guimaraes, L., 2000. *A cor como informação: a construção biofísica, lingüística e cultural da simbologia das cores*. 2.ed. São Paulo: Annablume.
- [8] Liu, H.; Singh, P. "ConceptNet: a practical commonsense reasoning toolkit". *BT Technology Journal*, v.22, n.4, 2004, p.211-226.
- [9] Lowgren, J., 2005. "Inspirational patterns for embodied interaction". In: *Nordic Design Research Conference (Nordes)*, Copenhagen, 9p.
- [10] Lukosch, S.; Schummer, T.; Jarmer, T. "There's more than just a Login: Six patterns that make connecting to a collaborative system more convenient". *EuroPlop*, 2007.
- [11] Maslow. *Motivation and personality*. NY:Harper, 1954.
- [12] Novaes, M. V. A Importância da Motivação para o Sucesso das Equipes no Contexto Organizacional. *Revista Eletrônica de Psicologia*, Ano I Num1, 2007.
- [13] Parrott, W. *Emotions in Social Psychology*, Psychology Press, Philadelphia, 2001, 378 p, ISBN 0863776833.
- [14] Pastoreau, M. *Dicionário das cores do nosso tempo*. Lisboa: Estampa 1997, 182p.
- [15] Sahllins, M. *Cores e culturas. Cultura na prática*. R Janeiro: UFRJ, 2004, 218p.
- [16] Salgado, L. *Motivação no Trabalho*. Qualitymark, 2005, 110p. ISBN: 857303565X.
- [17] Schummer, T.; Lukosch, S. *Patterns for Computer-Mediated Interaction*. John Wiley & Sons, 2007, 600p. ISBN: 978-0470025611.
- [18] Silveira, L. M.; Buchdid, S. B.; Silva, J. C. A. "Metodologia de Aplicação de Cores no Projeto WEB". In: *XIWebMedia*. P. Caldas, 2005, pp.97-126.
- [19] Soto, E. *Comportamento organizacional: o impacto das emoções*. SP: Thompson Learning, 2005, 306p.
- [20] Sun. "Building a Culturally-Competent Corporate WebSite: An Exploratory Study of Cultural Markers In Multilingual WebDesign". In: *ACMSIGDOC2001*, 8p.