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Kansei Colour Concepts to Improve Effective Colour Selection in Designing Human Computer Interfaces

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Abstract

Colours have a major impact on Human Computer Interaction. Although there is a very thin line between appropriate and inappropriate use of colours, if used properly, colours can be a powerful tool to improve the usefulness of a computer interface in a wide variety of areas. Many designers mostly consider the physical aspect of the colour and tend to forget that psychological aspect of colour exists. However the findings of this study confirm that the psychological aspect or the affective dimension of colour also plays an important role in colour Interface design towards user satisfaction. Using Kansei Engineering principles the study explores the affective variability of colours and how it can be manipulated to provide better design guidance and solutions. A group of twenty adults from Sri Lanka, age ranging from 30 to 40 took part in the study. Survey was conducted using a Kansei colour questionnaire in normal atmospheric conditions. The results reveal that the affective variability of colours plays an important role in human computer interaction as an influential factor in drawing the user towards or withdrawing from the Interface. Thereby improving or degrading the user satisfaction.

Key words: *Computer Interfaces, Kansei, kansei Engineering, colours, Visual design, Affective variability of colour.*

1. Introduction

Colour is a major component in Graphical User Interfaces (GUI). Due to the development of GUI applications on computers and in the Web, the examination of colour has become a pertinent factor in computer and web application design. The effective use of colour can improve the performance of an application while in effective use of colour can degrade an application's performance and lessen user satisfaction. Therefore using colour effectively requires careful coordination with colours and their other associated dimensions.

Although there are abundance of design guidelines and recommendations available for selecting colours for interface designing, designers still fail to cater for the fullest satisfaction of individual user needs. In searching the reasons for the above issue, the designer's ignorance of affective ('Affect' is a neurophysiologic state that is consciously approachable as a simple non reflective feeling [1].) dimension of colour in interface designing was detected as a dominant factor; what a user psychologically feels for the interface and how the user psychologically drawn towards or withdrawn from the Interface. Although there are existing emotion - colour spaces, formulae and image scales which can be used to understand the affective variability of colours in computer Interfaces [2][3][4][5][6][7], they commonly provide algorithms and guidelines in an abstract or in a rigid manner. Therefore underlying colour-emotion factors are poorly understood, making it difficult to understand without the aid of a practical approach. In order to address these issues, in existing research, our study presents a new research paradigm and solution methodology based on Kansei Engineering techniques to appraise prospective user's affective variability of colours and provide better guidance to improve the colour usage in human computer interfaces.

2. What is Kansei?

Several scholars have given various definitions for Kansei. What is highlighted by many of them is that Kansei is a subjective internal process in the brain which is activated by external stimuli. Nagamachi in his studies futher explains this concept by articulating that "Kansei is an individual's subjective impression from a certain artefact, environment or situation, using all the senses of sight, hearing, feeling, smell, taste as well as recognition" [11]. Lee et al. further elaborating the word 'Kansei' says that the word Kansei is embedded with more semantics such as sensibility, sense, sensitivity, aesthetics, emotion, affection and intuition [12].

3. How Kansei is measured?

Even though it is very difficult to capture one's Kansei, it can be approximately measured using the following four different methods: people's behaviours and actions; words (spoken), facial and body expressions; physiological responses as such heart rate, electro myo graphy (EMG), electro encephalo graphy (EEG), etc [11]. While Some Kansei researchers prefer physiological methods which can directly measure user's Kansei while a user is actively interacting with the setup. Some prefer psychological methods such as self reporting, Semantic Differential Analysis methods etc. Some Kansei researchers adopt both measuring methods to find better solutions [15]. However this study fully focuses on a psychological method, semantic differential analysis (SDA) as the main Kansei measurement method which was designed to measure the connotative meaning of objects, events, and concepts [13].

Kansei knowledge gaining process follows a hierarchical model. If collected Kansei data were represented by a pyramid, primary data belongs on the bottom level or the basement of the pyramid. When data are analysed further, according to its refined level, they go higher in the pyramid until they reach the peak of the pyramid where we find the highest level of Kansei or general Kansei. Lower degree of Kansei is more subjective or individual than higher levels of Kansei. Highest level of Kansei is more refined and generalised, and from that data new design principles can be derived. Utilising this Kansei Knowledge to design new applications or, in other words, to translate consumers' feelings towards a product into design elements is called Kansei Engineering (figure 1). Kansei is a word originates from Japanese culture. Although there is no direct translation for Kansei in English language, engineers commonly represent it by the English word 'affective' and Kansei engineering as Affective engineering.

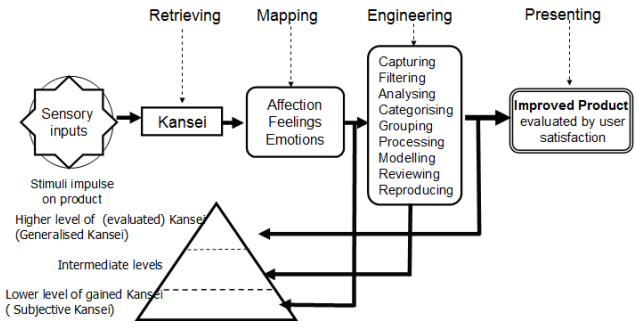

Fig.1: Working Principal of Kansei Engineering

4. Subjects & Material

20 male and female Sri Lankan adults (government employees) have taken part in this research as subjects. Test subjects' age ranged between 40 and 60. No subjects reported in any colour deficiency. Eleven colours were selected as the colour

Table 1: Selected colour palette.

Colour	RGB Value
Red	255, 0, 0
Orange	255, 165, 0
Brown	165, 42, 42
Yellow	255, 255, 0
Green	0, 128, 0
Blue	0, 0,255
Purple	128, 0, 128
Pink	255, 192, 203
White	255, 255, 255
Grey	128, 128, 128
Black	0, 0, 0

sample (Table 1). These colours are generally known as the colours that were 'almost never confused' throughout the cultures: red, pink, purple, blue, green, yellow, orange, brown, white, grey, black [14].The RGB values of the colours are displayed in Table 1. In addition to that, ten highly ranked Kansei words were selected to design bi-polar scales: angry–not angry, sad-not sad, fearful-not fearful, surprising-not surprising, bored-not bored, happy-not happy, exciting-not exciting, affectionate-not affectionate, pleasant-not pleasant. Finally a colour questionnaire was prepared consisting bi-polar scales as well as other open ended questions to gather general and other related information.

5. Methodology

Experiment was conducted in a quiet room in normal day light conditions using a questionnaire prepared using Kansei Engineering principals. The questionnaire consisted of three consecutive sessions: preliminary data acquisition, detailed data gathering, and final questionnaire testing with bipolar scales. Medium of the questionnaire is the subjects' native language (Sinhala). The questionnaire was separated in to three sections. The fist section of the questionnaire tested the direct colour affective associations in terms of mapping colours with appropriate kansei words and providing reasons for these associations. Second part of the questionnaire was aimed at affective variability of colour and interface designing, finally the third part of the questionnaire measure affective variability of colours using semantic differential scales.

Kansei words are emotion related adjectives in the subject domain and they can be used as representatives of the affective variability of participants. Therefore using these Kansei words in semantic differential analysis scales, affective variability of participants towards colours can be quantified. Kansei words were selected using various collection methods such as by participants themselves, statistical methods, affinity diagrams and expert judgment. Bi-polar scales were designed using these Kansei words and using these bipolar scales subjects were asked to quantify their affect for individual colours (testing colour samples against bi-polar scales). Finally the result was statistically analysed to find the trends of affective variability of colour in Interface designing.

6. Results and Discussion

Results are categorized into 2 important subjections. In the section 6.1 three trait Kansei words were selected to highlight relationship of affective variability of colour and the computer interfaces. In section 6.2, the influence of affective variability of warm and cool colour usage in interfaces was compared and discussed with the previous research work.

6.1 Affective variability of colour and Interface designing.

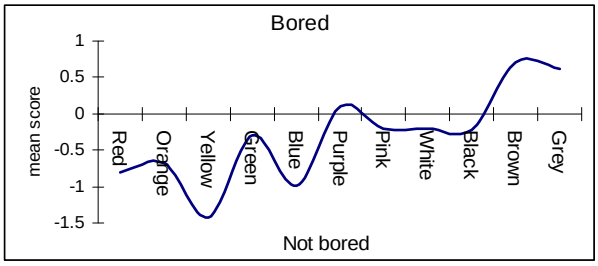

Fig. 2: Illustrates the Subjects' affective variability for in the domain of Kansei word bored which has a negative connotation. Therefore higher values were achieved for colours which generate negative affect and lower values were achieved for colours which generate positive affect.

To gain domain specific affective knowledge, considerations of trait kansei words are more important and useful. In figures 2, 3, 4 bi-polar scales result of three trait kansei words were illustrated. The bi-polar scale bored – not bored is a negative kansei word based bipolar scale. Kansei word bored is associated with gray and brown and the other colours are deviate from the semantic end bored and associated mainly with not bored (figure 2). Therefore on the basis of affective variability of gray and brown it can be argued that dominant use of these colours in interface designing may not impress the users.

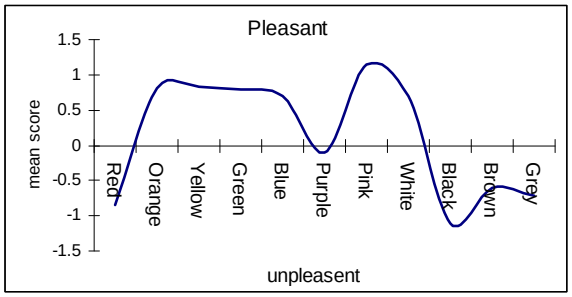

Fig. 3: Illustrates the subjects' preferences in mean value for colours in the domain of Kansei word pleasant. Higher values were achieved in the descending order, pink, yellow, orange, blue etc. Lowest values were achieved for colours grey, brown and black comparatively.

Moreover the other two bipolar scales selected are pleasant - unpleasant and exciting and unexciting. These two scales are positive kansei words based bi-polar scales. Positive values gained by colours for these scales were drawn towards the positive end of the bi- polar scale and negative values drawn towers the negative end of bi-polar scale.

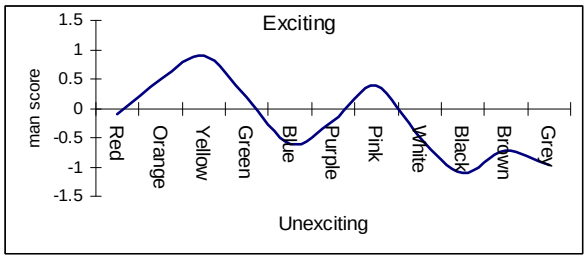

Fig. 4: Illustrates the subjects' preferences in mean value for colours in the domain of Kansei word exciting. Comparatively higher values were achieved in the descending order, yellow, pink and orange etc. Lowest values were achieved for colour grey, brown and black.

The colours such as brown, gray, black and red have scored negative values for pleasant - unpleasant scale (figure 3), which means the tendency of affective variability of these colours are towards unpleasant. On the contrary remaining colours have scored positive values, which draw the tendency of these colours towards the semantic border of pleasant. Therefore according to the results of this study for kansei word pleasant, mostly warm and cool colours induce pleasant feelings except red, brown and purple. Furthermore for kansei word pleasant, neutral colours such as grey and black induce unpleasant affect except white.

According to bi-polar scales exciting – unexciting (figure 4), yellow has scored higher positive value for kansei word exciting than it was for kansei word pleasant and pink has gained less positive value for kansei word exciting compared to the score pink was gained for kansei word pleasant. Although there are slight differences in the selection of the colours for kansei word pleasant and

exciting, the colours gray, brown, and black have gained negative scores and were drawn towards the negative semantic end of these positive bi-polar scales remain constant in both cases (figure 4). In the both bi-polar scales these colours have gained negative values which in essence are more drawn towards the negative border of the two kansei words pleasant and exciting. Consequently it can be seen that black, brown and gray do not induce positive affect in this study. Therefore according to the affective variability of these colours in this study it can be argued that using these colours dominantly in interface designing will not impress the users.

Examining the outcomes of above three bi-polar scales, (bored, pleasant and exciting) clues for generalised aspect of affective variability of colours can be drawn. In essence, brown and gray are unpleasant, unexciting and bored colours. On the contrary pink, yellow, orange, green, blue are pleasant and exciting colours. Thus how is this knowledge of knowing the affective variability of colour useful for a designer? Knowing the trend of user affective variability, designers get added advantages to make a better judgment for selecting colour palette for respective interface designing. With regard to this results, when planning to get use of colours associated with bored, unpleasant and unexciting, it should be careful about to what extend these colours should be used; how these colours can be balanced to make colours combinations to be combined with highly preferred colours.

Moreover, results reveal that, as colours black, grey and brown are not so exciting or pleasant while colours as blue, yellow, pink green comparatively have higher preferences. With regard to this results, when one plans to get use of so called bored, unpleasant colours, he needs to be careful to what extend these colours should be used; how these colours can be balanced to make colours combinations to be combined with highly preferred colours.

6.2 Manipulation of Warm and Cool Colours utilising Kansei concepts.

Colours should be used in a way not only to add excitement and flavour to the interface but also to improve the functionality and usability. For an instance cool soft colours does not show any dominant associations with any of the extreme positive or negative kansei words (except pink) but these colours commonly have gained higher value for kansei word pleasant (figure 6). Therefore looking at the slightly positive affective nature of these colours it can be argued that these colours are capable of keeping ones mind at rest and provide an environment to work for a longer period of time. On the contrary warm colours that generate warm feelings draw attention instantly than others do; they also put our mind at agitation which is also uncomfortable to associate for a longer period of time. For an Instance colour red has gain highest value for negative kansei word angry which is a representation of an aggressive atmosphere. (figure 5). This argument can be further strengthened by comparing it with the result of a previous study which investigated the effect of colour on human emotions. This previous study detected that red and yellow were stimulating and disagreeable colours. Further these colours draw attention of people on outward environment. Moreover these colours are forceful, expressive and provocative of behaviour. The same study found that the green and blue were restful colours; quieting and agreeable. These colour-associations draw people's attention inwards and cause reserved and stable behaviours [17].

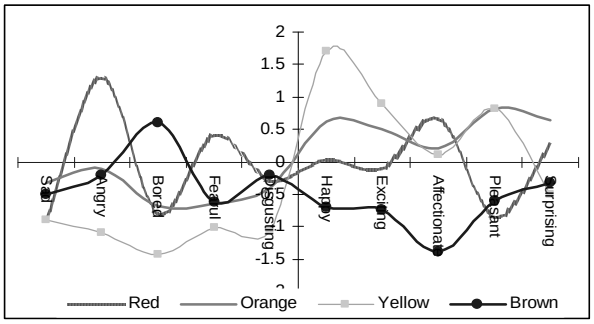

Fig. 5: Illustrates variation of warm colours for selected Kansei words. These colours are considered as warm colours or colours which has a high temperature effect. Red is considered as the warmest among all colours which have the highest value for Kansei word angry.

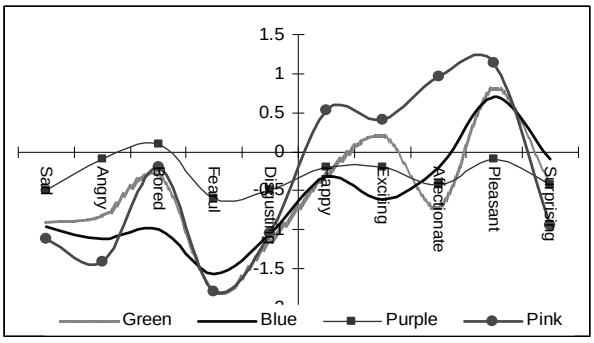

Fig. 7: Illustrates variation of cool colours for selected Kansei words

Therefore it can be argued that warm colours such as red, yellow, and orange are better solution for highlighting and drawing one's attention to particular areas of the Interface and also can assist in enhancing the visual search. Nevertheless according to their arousing and dominating nature warm colours should not be selected to represent a larger area of a computer interface since they may degrade

the performance of the application. On the contrary, cool colours (see figure 6) are soft and calming to the eye as well as to the mind.

Another previous study reveals that while warm colours in the red colour system arouse genial, positive, active feelings, cool colours such as green promote moderate, calm, ordinary feelings.[16]. Therefore these attributes that a cool colour comprises make them better candidates for background colours and theme colours. Figure 6 illustrates the representation of cool colours for the same Kansei words selected for the warm colours. Although blue and green are mostly associated with positive feelings, altogether all the colours in the cool colour graph do not show significant representation for positive or negative feelings. This clue indicates that cool colours make better background and theme colours because of their tendency towards balanced representation of feelings.

8. Conclusion

This study discusses how Kansei engineering concepts can be put in to practice in selecting better colour solutions to design human computer interfaces. Making better colour decision and customizing it to the needs of user is never a simple task. Particularly when the designer is a programmer himself, it would be helpful if there are already existing systems which he can get assistance to select better colours choices. Although there are already existing systems to recommend good colour themes, it is doubtful that these readymade generic colour themes can fulfill prospective user needs. Experienced designers can overcome this problem by adopting an existing colour scheme and customise it to prospective user needs. But for inexperienced designers it would be greatly helpful if he can get use of simple mechanism to get a proper idea about the affective variability of the prospective users.

One of the advantages of conducting a Kansei survey is revealing the users feelings or affectivity towards colours beforehand. While providing assistance to selecting better colour schemes Kansei concepts reveal another dimension of colours as such the user's affective interaction towards colour. Analysing and generalising these affective interactions, designers can get a better idea about the user's impression towards colours. Furthermore focusing on affective variability of colour in designing a human computer interface is an extra aid to improve the simplicity, consistency, clarity and handling cultural differences to improve the quality of the design.

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