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Intelligent Color Control for Display Panel

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ABSTRACT

Human's sight holds the most extents among other senses. It will become more beneficial in person's emotion or body, if we form much better environment to human in connection with visual information as importance of visual information. Human is using a lot of display units on modern society. Basic colors that compose these are Red, Green and Blue. Using these three colors, we can change color sense of monitor or brightness degree. Suitable color degree by individual's environment can reduce person's stress or give comfortable feeling. So Factors by human's emotion and environment are standardized using fuzzy and the method that is to apply the result of Intelligent Color Control(ICC) on display is proposed.

Key Words : Color propensity, Fuzzy logic, Intelligent control, Emotional color

1. INTRODUCTION

There are a lot of variables to express human's character. Particularly considering the variables is important to improve human-friendly products. Some of the variables are suitable to standardize but others are not. Human's emotion is known that is one of most difficult variable to standardize. This Paper was researched that human's emotion is standardized with fuzzy to use general effect of color. Color affects human's emotion.[1][2] The psychological attitude regarding a color will affect physical reaction. For example, the red is exciting and stimulating. And the blue color is easy to feel cool and calm. The green does to feel joyful and comfortable. The psychological change with a color goes effective to behave. Therefore, it is effect in the whole of the human being. The color is so useful as to treat diseases.

If we know the color propensity which is able to affect good efficiency to us, we can reduce stress and ill feeling and feel comfortable using the color.[3][4] It can be spoken as human central technical development that considers human's sentiment as well as physical and spiritual convenience of human.[5] I used Fuzzy reasoning with emotion curved line of biorhythm that is universal tendency to consider the uncertain side of sensitivity.

Recently we use diverse displays, television, computer monitor, mobile phone, portable multimedia player and others, and spend much time for work or hobby with display. So, if the screen is considered user's environments and affects user better, the small effects will be piled up and have big influence to user. In this paper, temperature, brightness and user's emotion are considered for user's environment, and with fuzzy inference color propensity is

proposed and variations of primary colors gain, red, green and blue, changes the screen to be profitable.

2. INTELLIGENT COLOR PROPENSITY

2.1 Efficiency of Color

Expression of color by light is formed with red, green and blue. Depending on each probability of color, variety colors or brightness is created. And variety colors bring up the several images as Table1.

Being in the room of red color, we feel more warmth. In this way, user's feeling differ according to the monitor of what color propensity even if they see the image data of the same contents in monitor. Users are usually using basic value of color gain or adjusted color value without control. Butcontrolling system that makes display affect goodness to user by emotional color propensity is proposed in this paper.

Table 1. Efficiency of Color

COLOR	ASSOCIATION
RED	life, warm, passion, sensitive, progressive
ORANGE	ambition, wisdom, warm, delight, love
YELLOW	light, prosperity, extension, noble, activity
GREEN	peace, health, stability, fresh, rest, comfort
BLUE	sea, youth, calm, peace, purity, cool, justice
PURPLE	force, direction, patience, modesty, elegance
BROWN	Earth, poverty, obstinacy, trust

2.2 Conditional Relations

Variation of display considered with conditions has color propensity that is chosen and decided based on Color psychology and calculation of conditional relations uses Fuzzy theory. User's condition is considered by 3kinds. First, depending on temperature of use circumstance, color propensity is considered whether warm or cool feeling is better. Second controls Brightness subtracting or adding all color for adjusting to adequate brightness of monitor that reduces tiredness of eyes concerned with around brightness. At last, user emotion of bio-rhythm is used for third condition.

2.2.1 Temperature

Input about temperature is based on 19~20°C that is suitable human to feel comfortable.

2.2.2 Brightness

In bright circumstance dark screen is not able to show definitely.

The primary colors - red, green and blue make white, that is, bright if they are added. And subtraction of their gain change to be dark. Degree of brightness is represented by lux (0~1000 lx).

2.2.3 Emotion

For inference of human emotion bio-rhythm that is most general and well-known is used. And it is proved by subjective validation and experience.

Bio-rhythm is composed with physical, emotional and intellectual lines and in this paper the part of emotion is used only.

Because the cycle of bio-rhythm is calculated by user's birthday, information about the time of birth is needed at first and using it degree of emotion is acquired from the followed formula.[6]

$$y=100(\sin(\frac{2\pi}{672}x)) \quad (1)$$

The value of emotion is from -100 to 100. And high value means better mind. But the value that is near 0, means danger. Because it is unbalance and makes accidents happen when the value is 0, the bound of 'RD' is specific to infer.

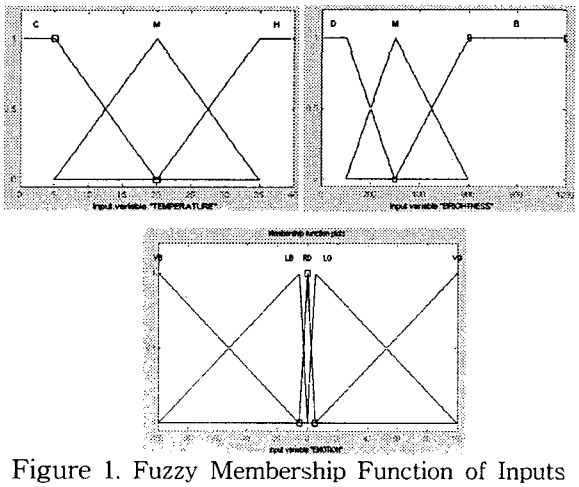

Figure 1. Fuzzy Membership Function of Inputs

2.3 Fuzzy Inference

As all fuzzy system is concerned to fit values of inputs, interrelationship between emotion and circumstance is important. If two different propensities are conflicted, the value of output is not able to display definitely different screen. But in detail tiny alteration will advantage unconsciously to user.

Result of ICC is tried to be objective in the subjective field. So in this paper emotional propensity is strived to keep its objectivity.

After fuzzy inference inputs of conditions yield gain values of three colors - red, green and blue. And for the inference rule table is as Table2.

Each output that is concerned with fuzzy rule conditions is calculated as follows.

Table 2. Rule Table of ICC

No.	Tem.	Bri.	Emo	R	G	B
1	C	D	VB	L	L	L
2	C	D	LB	M	L	L
3	C	D	RD	L	L	L
4	C	D	LG	M	L	L
5	C	D	VG	M	L	L
6	C	M	VB	H	H	M
7	C	M	LB	H	M	M
8	C	M	RD	M	H	H
9	C	M	LG	H	M	M
~	~	~	~	~	~	~

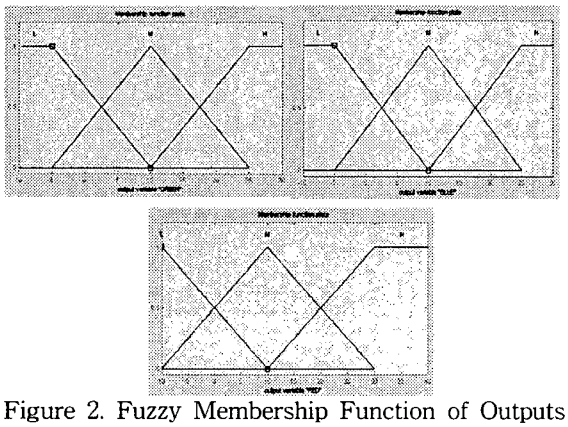

Figure 2. Fuzzy Membership Function of Outputs

Each summation of output value that is color gain for inferred propensity is result of ICC. The summations affect colors of screen and it does not control only the tone of color but also brightness.

3. SIMULATING APPLICATION

The Matlab Simulation is used to simulate ICC and compared pictures of result will be shown instead of screen. Degrees of temperature and brightness standardized are determined by equipments or sensors easily.

On assumed several conditions the following results were gotten by ICC. And fuzzy inference generates with Mandani method and for defuzzification Mean of maximum method(MOM) is used.[7][8][9]

Table 3. Results of ICC with Fuzzy inference.

Tempe-rature (20)	Bright-ness (300)	Emotion (0)	Red Gain (10)	Green Gain (10)	Blue Gain (10)
7.5	180	-50	13.8	8.73	4.85
7.5	300	50	22.3	10	10
15	480	92	25.1	15.7	15.7
20	100	1	-3.26	-2.68	8.57
22	350	98	25.3	11.2	11.2
23	450	-22	17.1	14.4	14.4
30	60	-78	-2.91	-2.33	7.38
30	100	47	6.07	-2.01	-2.01
32	250	-3	9.27	11.3	13.3
35	460	10	18.1	14.8	21.9
35	600	70	28.2	22.4	22.4

The numbers of parenthesis are basic values. And color gains of output which should be changed are gaps from basic values.

When temperature is 7.5°C, Bright is basis and emotion is good(+50), the screen that is active and warm tone will make user feel favor. So, if the following pictures which are applied alternations of result are compared, color of original picture is shown that it changes to add red gain more that makes user feel warm and exciting.

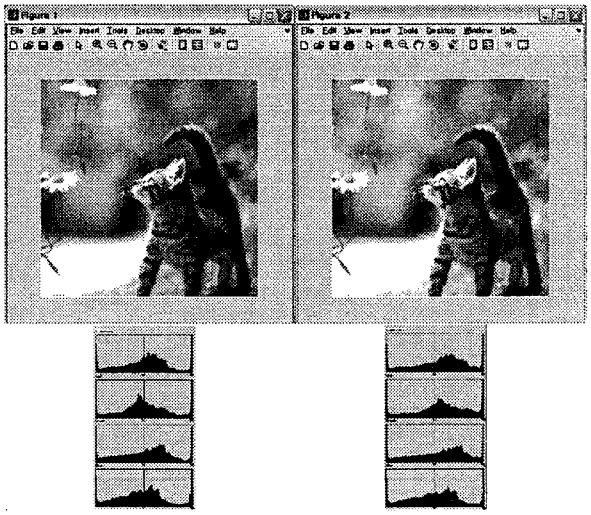

Figure 3. Compared Screens and Histograms

On those conditions red gain is increased as 22.3, green is 10 and blue is 10. If outputs are compared with basic value 10, increasing value of red gain means intention to let user feel warmth in cold environment. With each histogram that is distribution about sums of each same degree of color or luminosity, especially distribution of red moves to higher degree. So, the simulation shows that the intention of color propensity is able to be realized using fuzzy inference.

At last, we got the degree of effect through questionnaire. On test, we checked the temperature and the brightness and testee's emotion. And we showed two pictures to testee to compare for result of this system using Matlab program.

As follows, 36% of 25 persons, 9, answered that the ICC effect is good and 36% others answered "very good" in winter term. In case of spring term, 50.9% of 57 persons answered "good" effect and 28.1% persons answered "very good". Totally over 76% people who joined the questionnaire have felt good effect. By the questionnaire, it is proved that the result of ICC is better than before.

Table 4. Results of Questionnaire

Term	Very Bad	Bad	Normal	Good	very Good	Total
Winter	1	2	4	9	9	25
	4%	8%	16%	36%	36%	100%
Spring	0	1	11	29	16	57
	0%	1.7%	19.3%	50.9%	28.1%	100%
Total	1	3	15	38	25	82
	1.2%	3.7%	18.3%	46.3%	30.5%	100%

Figure 9. Total Result of Questionnaire

4. CONCLUSION

In this paper, intelligent color controller for human friendly display, which is able to advance display technology, is presented. The effectiveness of the proposed Intelligent Color Control was demonstrated by a computer simulated and questionnaire. This system that controls tones of color on display has a good influence and it will contribute to make more intelligent display product of higher quality. If other various conditions are considered, efficiency of this system may improve still more. When we design various application products as well as display, it is better to consider user's emotion with applying fuzzy logic. Because it is time that should develop product technology for considering user's convenience.

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