COLOR SCENARIO OF ECO&HEALTHY DRIVING FOR THE RGB LED

Hyeon-Jeong SUK, KAIST  |  International Conference on Consumer Electronics 2013
OVERVIEW

1. INTRODUCTION

2. OBJECTIVE

3. EXPERIMENTATION
   [PART I, PART II, PART III]

4. RESULTS
   [COLOR SCENARIO OF ECO & HEALTHY DRIVING]

5. CONCLUSION
INTRODUCTION

Luminescent Color Surface as Product Color

✓ Displays can also use emotional and symbolic features of color to portray various information about a product (i.e. products’ current status)

✓ RGB LED opens door to new possibilities
FOCUS

Dynamic color research

Climate Control Device (CCD)
RESEARCH NEED

Halla Climate Control
OBJECTIVE

Design **background color** for interface display of climate control devices (CCD) to **increase user satisfaction** and **boost marketable competitiveness** of interface displays as consumer product.
Part I

Finding the Scenario of Color of Interface Display
PART 1  OBJECTIVE & METHOD

To find a scenario of in-car information deliverance in which information is effectively portrayed to the users through color presentation of interface display.
PART 1  COLOR SCENARIO GENERATION

Color scenarios (combinations of CCD measurements (units)and color attributes)

**CCD Measurements**
- Value of solar radiation
- In-car temperature (°C)
- Discharge temperature (°C)
- Blow level
- Outside temperature (°C)

**Color attributes**
- Dominant wavelength (nm)
- Luminance (cd/m² or nit)
- Purity (%)

**EVALUATION CRITERIA**
- Is it interesting?
- Is it informational?
- Is it inspiring?
### PART 1 Finding the Scenario of Color of Interface Display

**THE FIVE SCENARIOS GENERATED IN PART I**

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Measurements read by Climate Control Device</th>
<th>Color Presentations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Value of solar radiation</td>
<td>Dynamically animated pure colors when one starts a car in daytime / Dynamically animated impure color when one starts a car at night</td>
</tr>
<tr>
<td>B</td>
<td>In-car temperature</td>
<td>Cool colors below 23 °C, Warm colors above 23 °C</td>
</tr>
<tr>
<td>C</td>
<td>Discharge temperature and Blow level</td>
<td>Change of dominant wavelength for discharge temperature, Increase of intensity* in proportion to</td>
</tr>
<tr>
<td>D</td>
<td>Temperature difference between inside and outside of car, Blow level</td>
<td>Increase of purity in proportion to increase of temperature difference, increase of intensity in proportion to blow level</td>
</tr>
<tr>
<td>E</td>
<td>In-car temperature above, below, or around 23 °C, Blow level</td>
<td>Cool colors below 23 °C, Warm colors above 23 °C, Another color around 23 °C, Increase of intensity in proportion to blow level</td>
</tr>
</tbody>
</table>

*Intensity refers to the combination of luminance and purity, similar to the concept of how luminescent light from object color is expressed as a combination of value and chroma.*
Part 1

Part 2

A User Test to Match Display Colors and In-car Climate Conditions
PART 2 OBJECTIVE & METHOD

BLOW LEVEL?

TEMPERATURE?
PART 2 USER TEST CLIMATE CONDITIONS

Twelve types of in-car climate

<table>
<thead>
<tr>
<th>BLOW LEVEL</th>
<th>TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>COLD (10 °C)</td>
</tr>
<tr>
<td></td>
<td>MILD (23 °C)</td>
</tr>
<tr>
<td></td>
<td>WARM (30 °C)</td>
</tr>
<tr>
<td>MEDIUM LOW</td>
<td>COLD (10 °C)</td>
</tr>
<tr>
<td></td>
<td>MILD (23 °C)</td>
</tr>
<tr>
<td></td>
<td>WARM (30 °C)</td>
</tr>
<tr>
<td>MEDIUM HIGH</td>
<td>COLD (10 °C)</td>
</tr>
<tr>
<td></td>
<td>MILD (23 °C)</td>
</tr>
<tr>
<td></td>
<td>WARM (30 °C)</td>
</tr>
<tr>
<td>HIGH</td>
<td>COLD (10 °C)</td>
</tr>
<tr>
<td></td>
<td>MILD (23 °C)</td>
</tr>
<tr>
<td></td>
<td>WARM (30 °C)</td>
</tr>
</tbody>
</table>
PART 2 USER TEST STIMULI

VIVID
PALE

STRONG
WEAK

VIVID
PALE

STRONG
WEAK

VIVID
PALE

STRONG
WEAK

VIVID
PALE

STRONG
WEAK

VIVID
PALE

STRONG
WEAK

WHITE 1  WHITE 2  WHITE 3  WHITE 4

BLACK
(DARK OLIVE GREEN)

VIVID
PALE

STRONG
WEAK

GREENISH BLUE

VIVID
PALE

STRONG
WEAK

BLUE

VIVID
PALE

STRONG
WEAK

BLUSH PURPLE

VIVID
PALE

STRONG
WEAK

PURPLE

VIVID
PALE

STRONG
WEAK

PURPLISH RED

VIVID
PALE

STRONG
WEAK

TOTAL COLOR STIMULI

45
PART 2 USER TEST STIMULI

STRONG VIVID GREEN  WEAK VIVID GREEN

STRONG PALE GREEN  WEAK PALE GREEN

45 color stimuli plotted in CIE Chromaticity Diagram; the shaded area is the color gamut of RGB LED of CCD
PART 2 STIMULI IMPLEMENTATION

Light Meter CS-100A of Minolta
PART 2 USER TEST PROCEDURE

Users were instructed to match one most appropriate interface display color to each of the twelve different in-car climate conditions.

Environmental condition: ~3pm (average of 300lx)

1. Experience 12 in-car climate conditions

2. Pick matching colors to condition from color stimuli palette

3. Evaluate color stimuli on CCD
## PART 2 USER TEST RESULTS

### THE FREQUENTLY SELECTED COLOR STIMULI (6 TIMES OR ABOVE) OF INTERFACE DISPLAY FOR EACH OF TWELVE TYPES OF IN-CAR CLIMATE

<table>
<thead>
<tr>
<th>In-car temperature (°C)</th>
<th>Blow level</th>
<th>Low</th>
<th>Medium Low</th>
<th>Medium High</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold</td>
<td></td>
<td>Weak &amp; Pale Greenish blue (11)</td>
<td>Weak &amp; Vivid Greenish blue (11)</td>
<td>None (None above 6)</td>
<td>Strong &amp; Vivid Blue (10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strong &amp; Pale Greenish blue (7)</td>
<td>Strong &amp; Vivid Blue (7)</td>
<td>Strong &amp; Vivid Greenish blue (7)</td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td></td>
<td>Bright Whites (7)</td>
<td>Weak &amp; Pale Yellow (7)</td>
<td>None (None above 6)</td>
<td>None (None above 6)</td>
</tr>
</tbody>
</table>

*Numbers in parentheses = frequency*
Part 3
Implementation of Eco & Healthy Driving
PART 3 IMPLEMENTATION OF ECO & HEALTHY DRIVING

COLOR SCENARIO OF “ECO & HEALTHY DRIVING”

1: strong & vivid red
2: strong & pale red
3: weak & vivid red
4: weak & pale red
21: strong & vivid greenish blue
22: weak & pale greenish blue
23: weak & vivid greenish blue
24: weak & pale greenish blue
43: medium dark white
PART 3  SCENARIO MOVIE
CONCLUSION

SUMMARY

 ✓ Use a range of colors for interface display to portray information intuitively

 ✓ Provides empirical validity on intuitive perception of color (i.e. warm and cool colors)

 ✓ Applicable to all climate based interfaces of various contexts
CONCLUSION

- Test color scenarios in other climate related products (household electronic products)

- Further investigate and analyze emotional responses of color display (how to obtain stress-related)

- Other color scenarios to intuitively portray information of different devices in cars
Q & A

THANK YOU