

# Thermal Design Display device to use the thermal tactile illusions “Thermo-Paradox”

Kumiko KUSHIYAMA(1) , Tetsuaki Baba(1) Kouki Doi (2) Shinji SASADA(3)

1)Tokyo Metropolitan University 2)National Institute of Special Needs Education 3)Japan Electronics Collage

## 1. Introduction

“Thermo-Paradox” is a thermal design display device to use the thermal tactile Physiological illusions that can interactively present patterns of warm and cool temperatures. The technological success of a compact 80-pixel, 9-inch thermal display allows text information to be conveyed by temperature, which has never before been achieved, and the device compactness increases the degree of freedom in presentation methods. We propose this unprecedented tactile expression as a device that can display thermal images that interactively match a visual image, using the tactile Paradoxical sensation produced by the ability to control the temperature of each pixel. (Fig. 1)

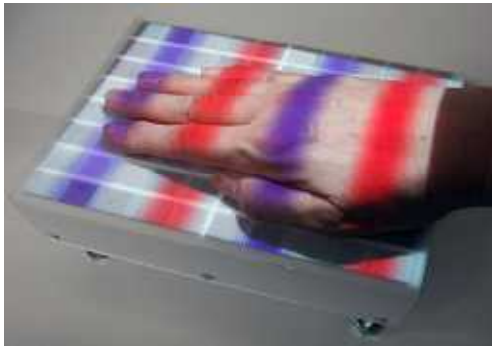


Fig 1. “Thermo-Paradoxical sensation”

## 2. System configuration

### 2.1 Outline

A 130mm x 170mm display that comprises a total of 80 Peltier elements in a 8 x 10 configuration occupying a 15 mm x15 mm mounted on a touch panel detects the position and time of touches on the screen, and the image and temperature are controlled simultaneously in accordance with the touches. The Peltier elements allows switching between heating and cooling of the surface. The devices are programmed so that they can be controlled individually for heating and cooling. (Fig. 2) By placing a projector on the upper part, an image can be projected onto the thermal display. The event module sends position data from the touch-screen to the image generator in real time.

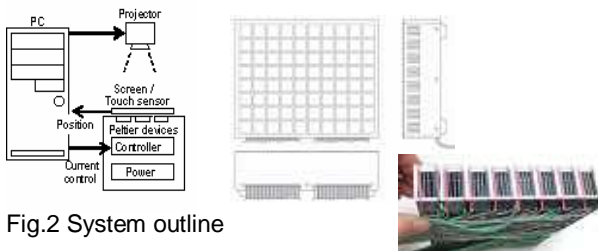
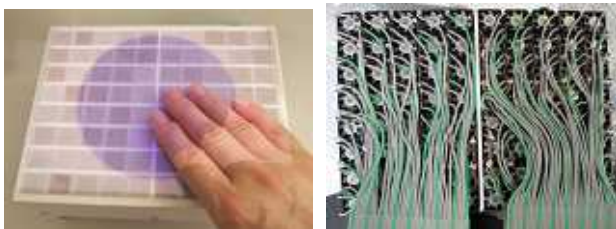


Fig.2 System outline



## 2.2 Image generation

The image generator uses the data sent from the event module to generate a 3-D image in real time with OpenGL. What kind of sensation results when the middle finger senses cold and the index finger senses warmth? The image and thermal display are controlled simultaneously to create sensations of moist and dry, bumps and dents on the surface and other such tactile effects in high-speed real time using vision and the thermo-tactile illusions produced by touching the warm and cool stripes. (Fig. 3)

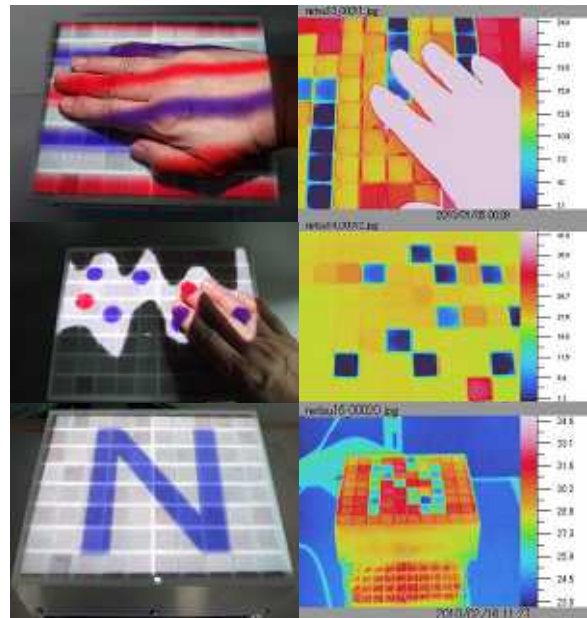


Fig.3 Image generation , Thermo Camera Image

The sense of cold is caused by the high temperature stimulation of 45\_ C or more. This is called paradoxical sensation. (Fig.4)

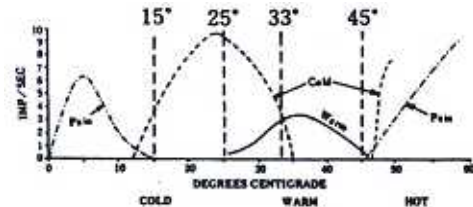


Fig.4 Specialized Thermoreceptor [3]

## 3. Conclusion

This work has yielded a compact thermal sensation display technology that can be used to create tactile sensations for a new kind of tactile communication that can be used in daily life. This product is expected to have a stimulating effect in a variety of fields, and present new creative opportunities.

### References

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- [3]Zotterman (1953) *Ann.Rev.Physiol*, 15 357-372