Multispectral Application for Real Color Appearance and Visualization of Skin Metabolism in Medicine

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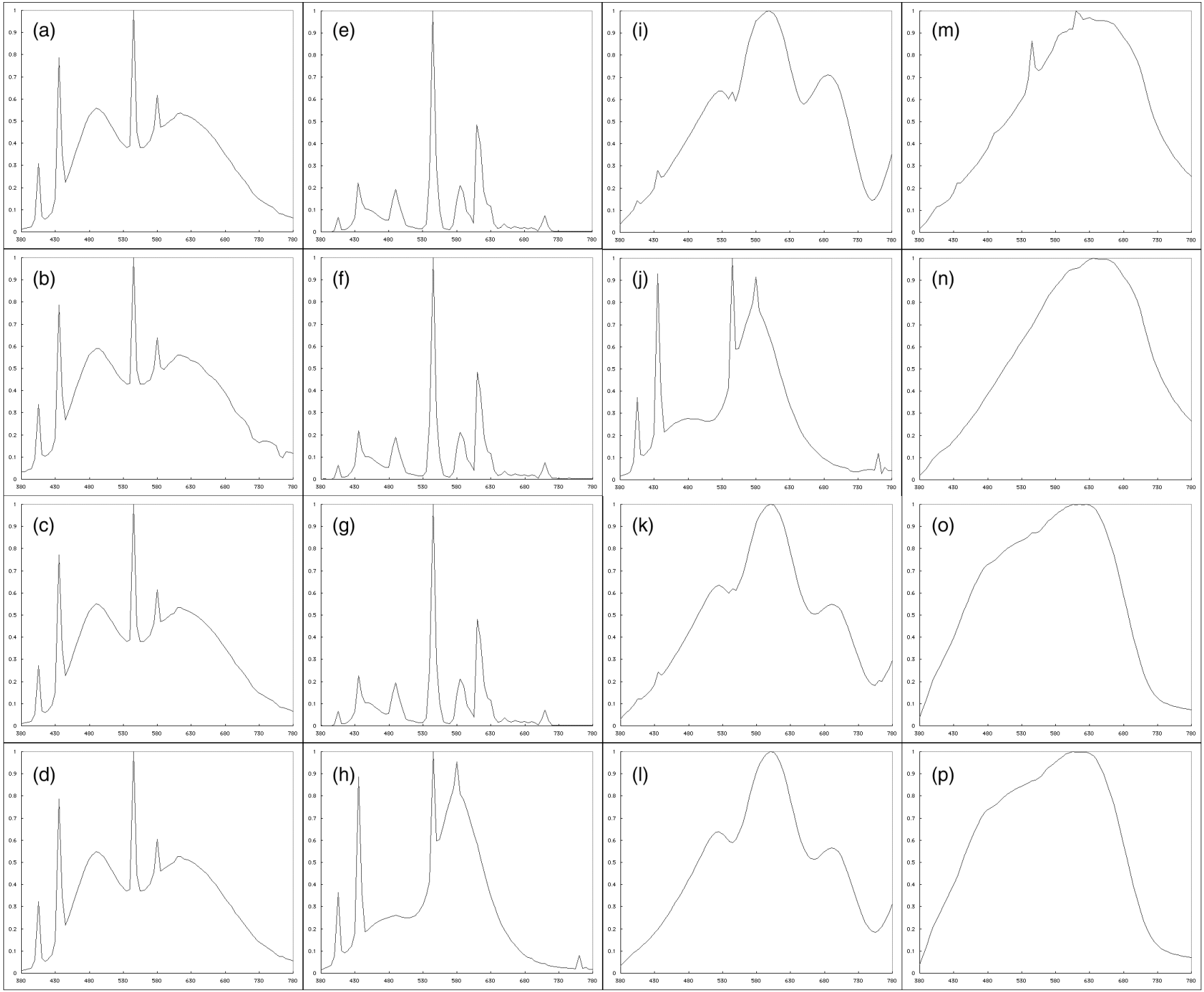
Purpose

- Providing Medical Real Color Appearance.
  - Device-independent color reproduction may be available by colorimetric color calibration, but it does not provide the same color appearance as real object independent of illuminant condition.
  - Real Color Appearance is the very thing required in medicine, not only mere color calibration.


(a)
(e)
(i)
(m)
(b)
(f)
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(d)
(h)
(l)
(p)

Spectral radiant distributions from 380 nm to 780 nm of wavelength measured at the following places.

	Place	Angles of measured plane	Ceiling light	Other lighting sources
[a]	An outpatient booth of dermatology	45° to the horizontal	on	(windows aside)
[b]	An outpatient booth of dermatology	45° to the horizontal	on	(facing to windows)
[c]	An outpatient booth of dermatology	vertical	on	(windows aside)
[d]	An outpatient booth of dermatology	horizontal	on	(windows aside)
[e]	A treatment room of a dermatology ward	45° to the horizontal	on	(none)
[f]	A treatment room of a dermatology ward	vertical	on	(none)
[g]	A treatment room of a dermatology ward	horizontal	on	(none)
[h]	An emergency outpatient unit	45° to the horizontal	on	(none)
[i]	A dental chair by the window	horizontal	on	an adjustable lamp
[j]	A dental chair by the window	horizontal	on	[windows aside)
[k]	A dental chair apart from the window	horizontal	on	an adjustable lamp
[l]	A dental chair apart from the window	horizontal	off	an adjustable lamp
[m]	A surgical bed in an operating room A	horizontal	on	surgical lights
[n]	A surgical bed in an operating room A	horizontal	off	surgical lights
[o]	A surgical bed in an operating room B	horizontal	on	surgical lights
[p]	A surgical bed in an operating room B	horizontal	off	surgical lights

Various Illuminant Conditions in a Hospital

Methods

- Because the three principal components are sufficient to approximate the reflectance spectra of skin and mucosa, they can be estimated by observation from a picture taken using a current three-band digital camera.

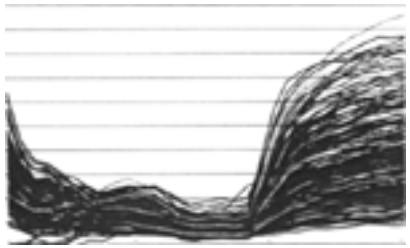
- Color appearance of skin and mucosa can be reproduced precisely using a current three-band display thanks to the characteristics of three kinds of human cone cells.

spectral reflectance

principle components

RGB values

estimated reflectance



(mucosa)

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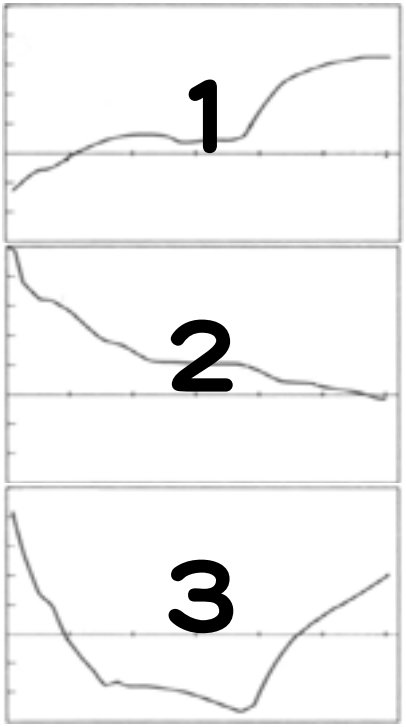
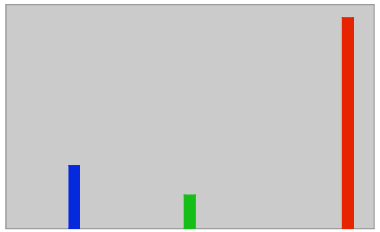


X [matrix calculation]



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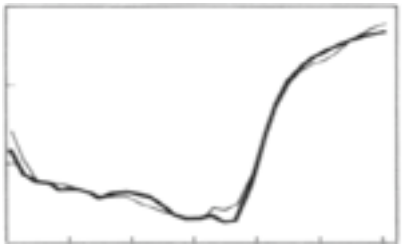

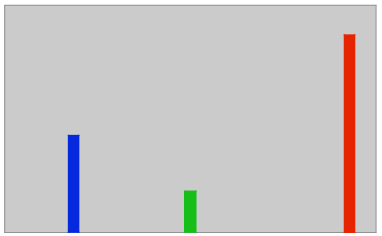

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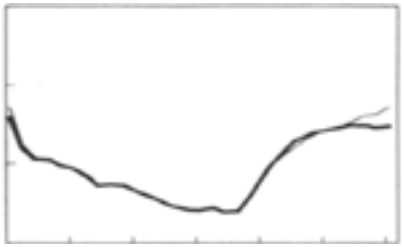
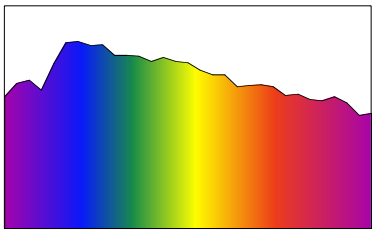


【source】 Yoichi Miyake : Analysis and Evaluation in Digital Color Imaging, University of Tokyo Press, 2000.

Estimation of Spectral Reflectance using Pictures Taken by a 3 Band Camera

Calculation of Color Appearance under Different Illumination

spectral radiance of illumination



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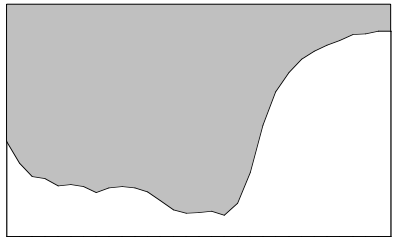
spectral reflectance of an object



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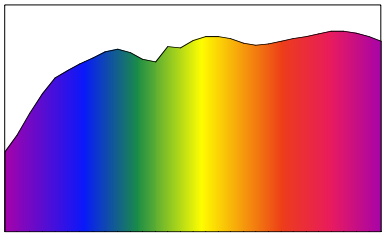
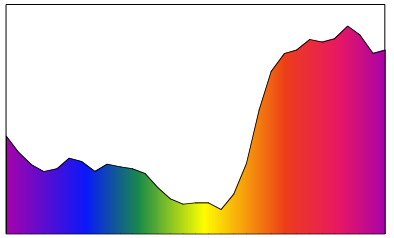
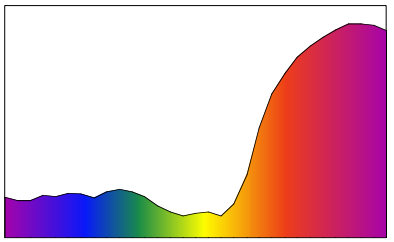
spectrum of reflected light

⇵ [integration]







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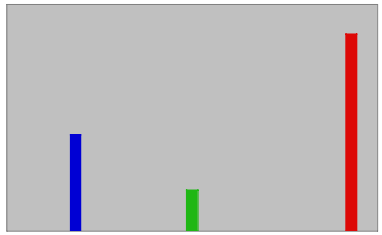
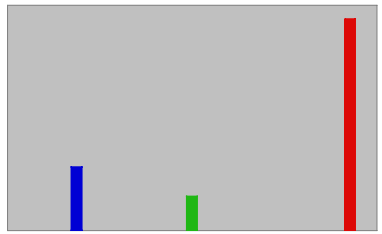
RGB values

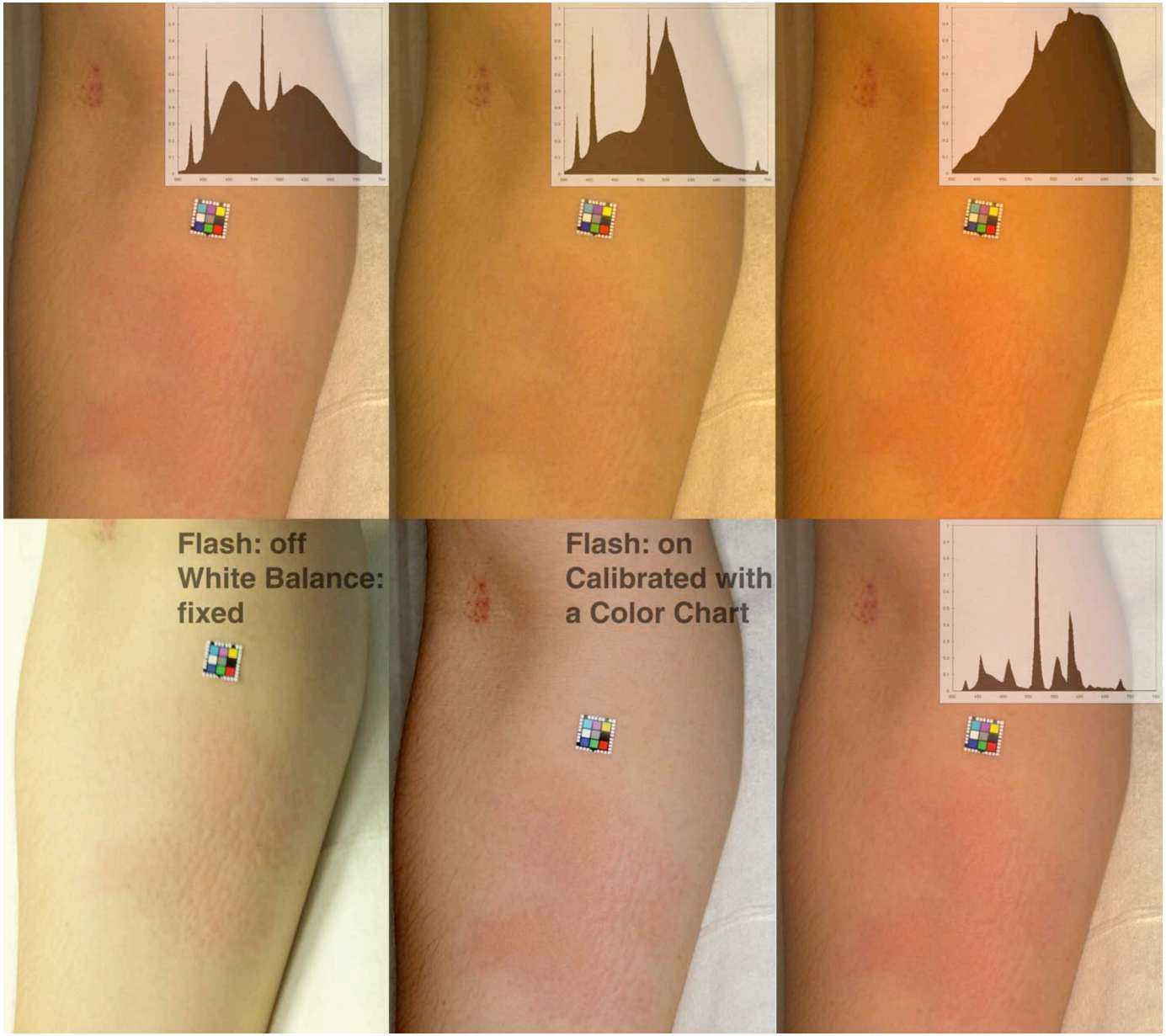




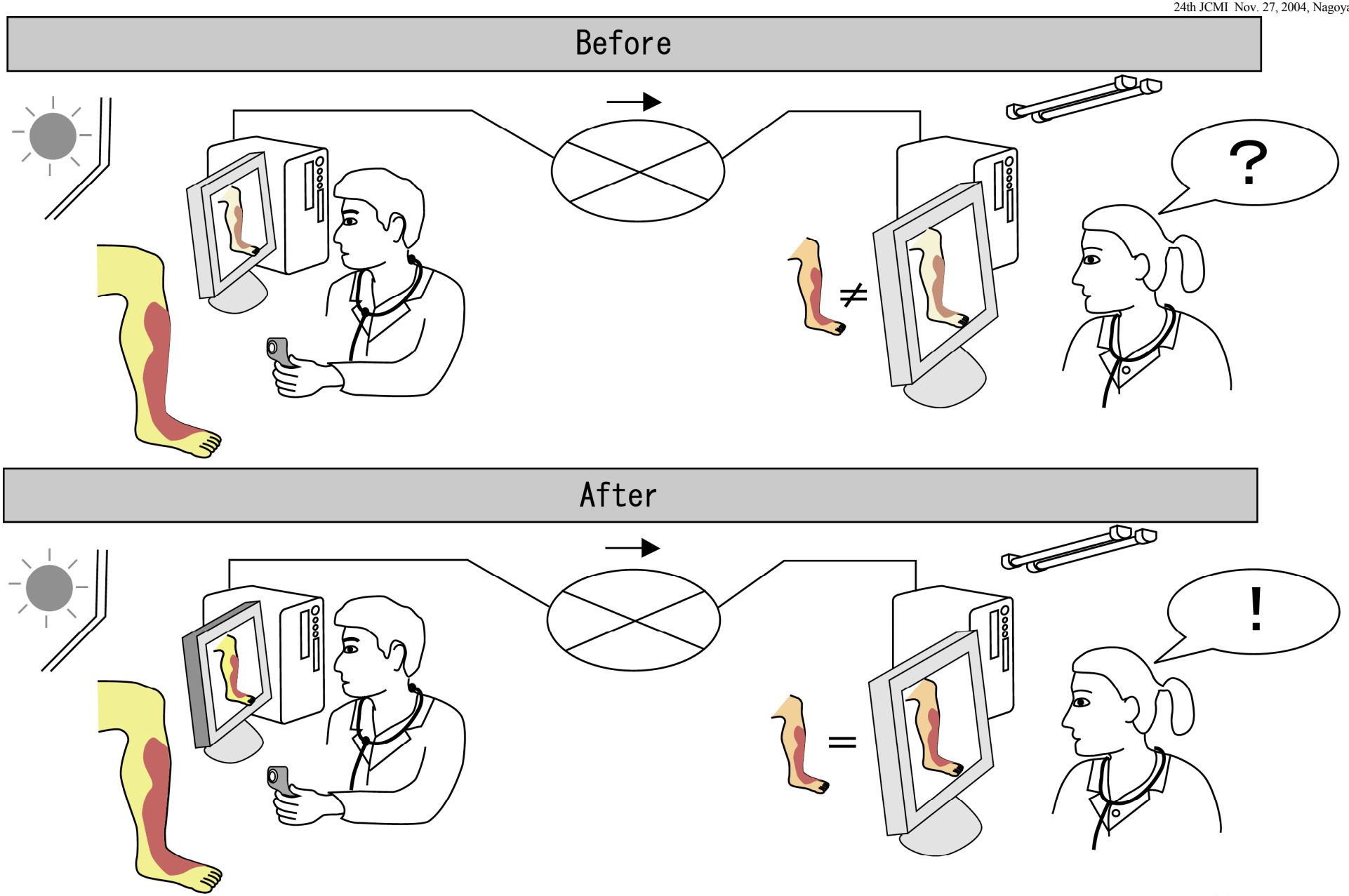
Results and Prospect

- Various illuminant conditions except very low color temperature, skin colors reproduced by our methods was very close to those of real objects.
- The distribution of oxyhemoglobin etc. will be visualized using estimated reflectance spectra of skin.

(a part of studies presented here is supported by Grant-in-Aid for Scientific Research, No. 15590480, from Japan Society for the Promotion of Science / Ministry of Education, Culture, Sports, Science and Technology of Japan)

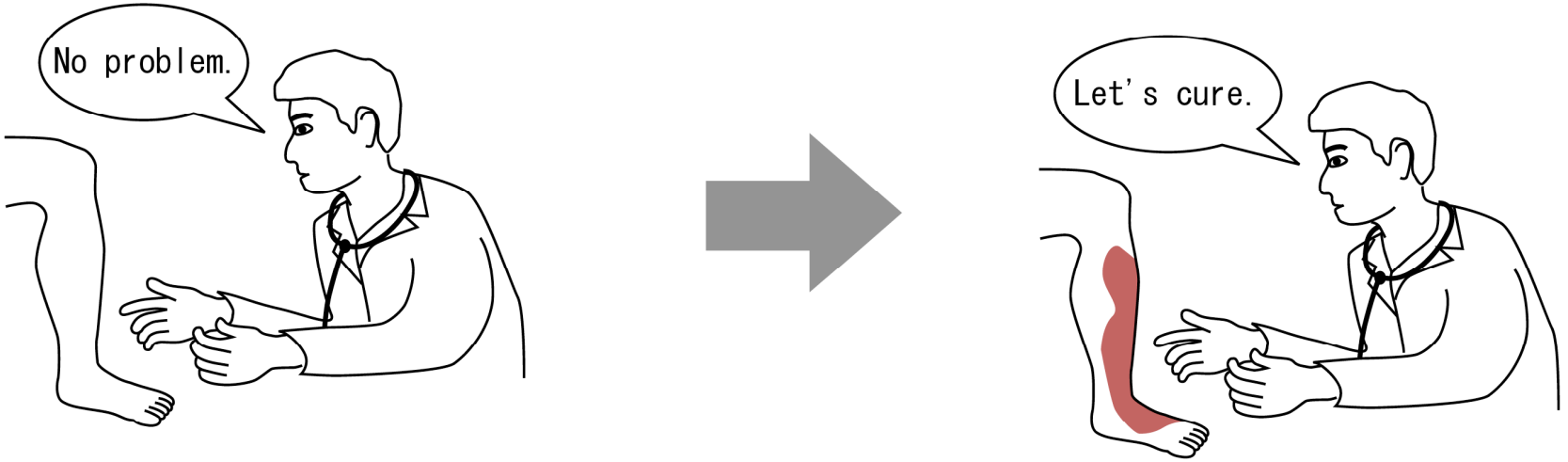


Real Color Appearance under Various Illuminant

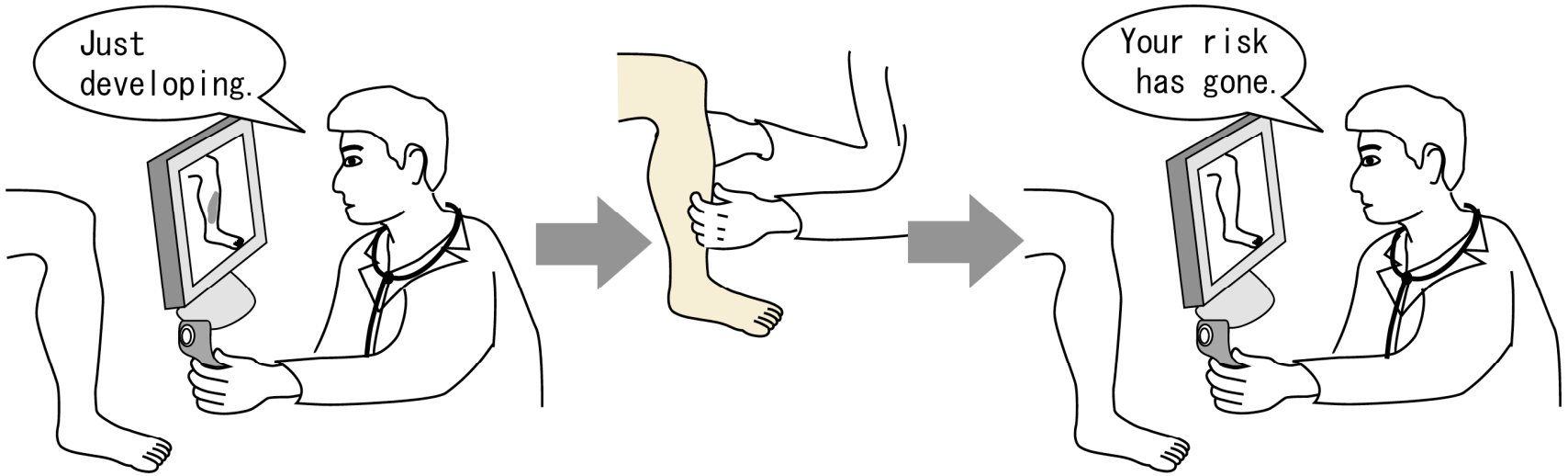


Application to Telemedicine

Physical Exam (Before)	Observation	Complication



Physical Exam (After)	Prevention	Successfully Prevented



Prospect of Predictive Medicine