Caracterization study of the human skin

MASTER'S DEGREE FINAL PROJECT – MASTER OF ENGINEERING

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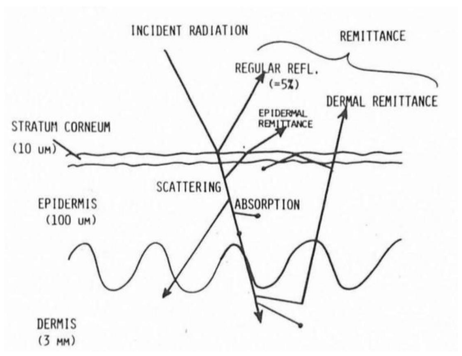
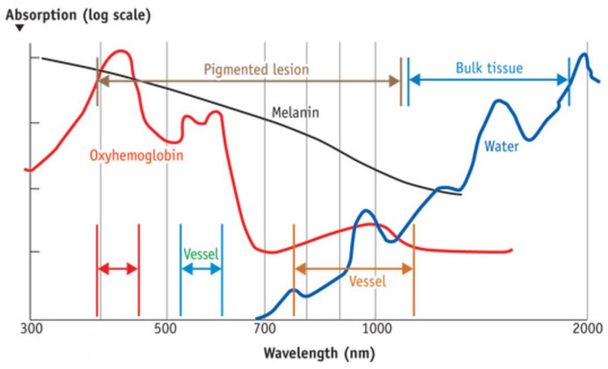
Skin – Light Interaction

- Identify skin chromophores with spectroscopy
- Analysing scattering diagram, for each angle

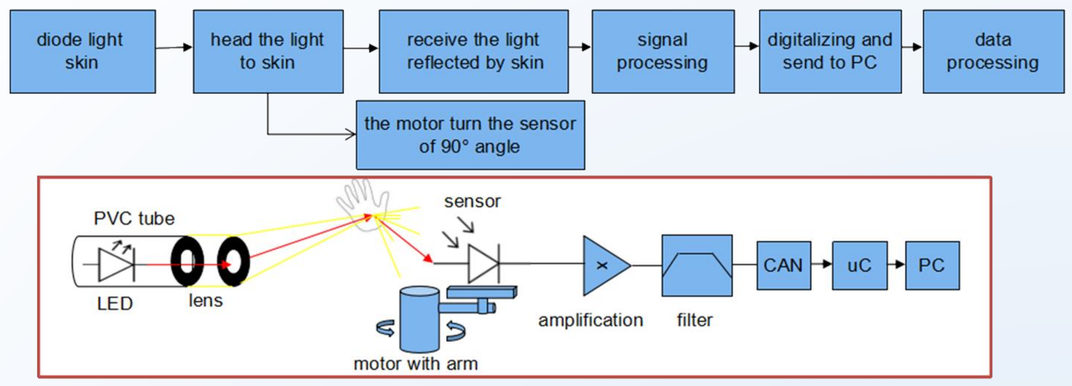


(1) Schematic diagram of optical pathways in human skin



(2) Absorption coefficients of different chromophores

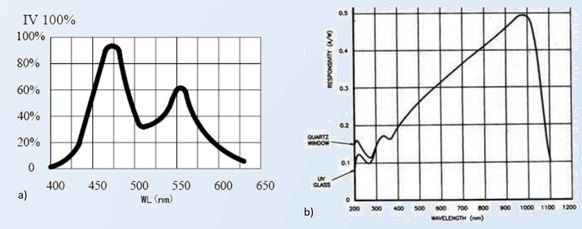
Instrumentation



(3) Descriptive diagram and schematic of the system

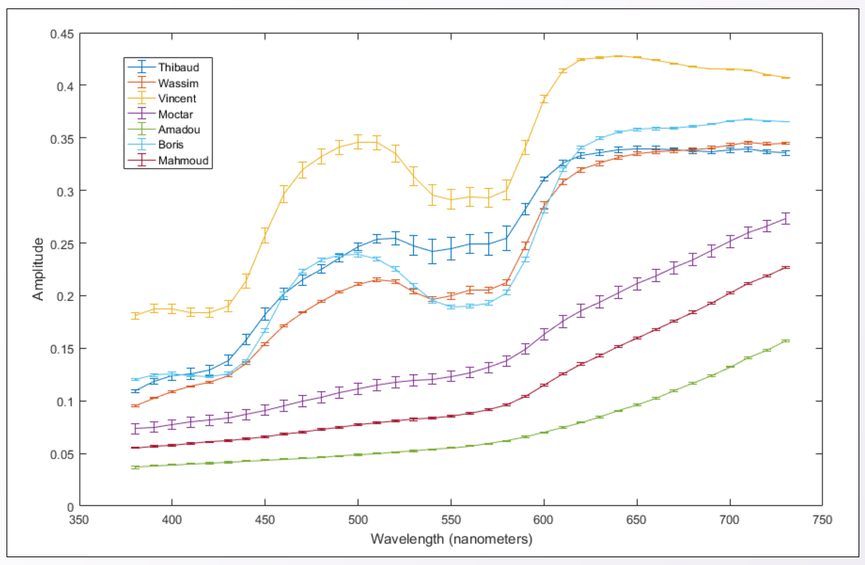
- Light isolated environnement
- Skin sample is lighten up with a LED by converging light through lenses
- Reflected light captured by the sensor (photodiode)
- Stepper motor providing rotational movement, several angles during the measurement
- Signal sampling by a micro controller

- Integration of the absorption spectrum of the skin : $\int S_E * S_S * S_R \, d\lambda$; S_E, S_S, and S_R are respectively the spectrum of emission, diffusion and receiver



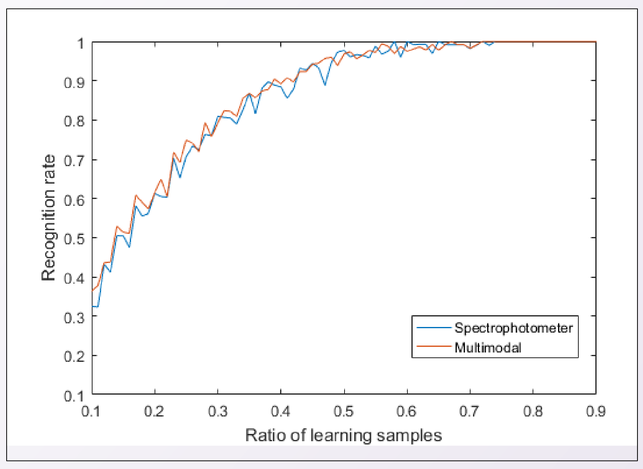
(4) Spectral response of the emitting (a, 5050 LED) and receiving (b, OSD 35-7X CQ) components

Experimentation results

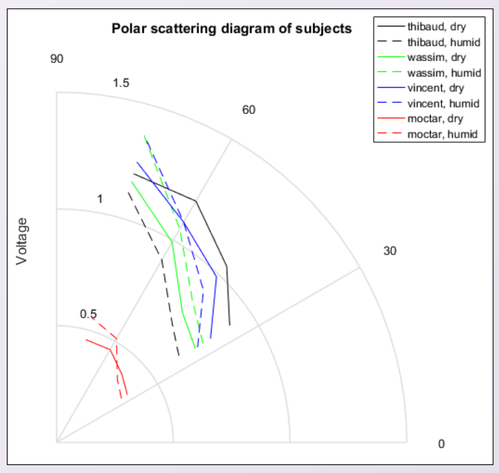


(5) Spectrum of skin samples acquired from right back of hand of each seven subjects

- 7 healthy subjects in order to chromophores identification
- 4 subjects to test and compare dry and humid skin, via spectroscopy
- Scattering diagram analysis for each angle
- Extraction of error bars (input data for recognition tool)
- Pattern recognition -> 100% accuracy

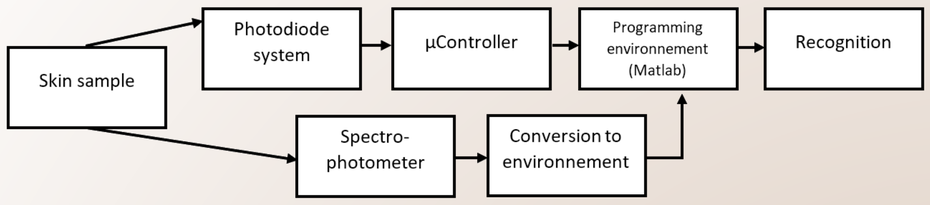


(6) Recognition rate for the two modalities of the recognition task.



(7) Polar scattering diagram of subjects

Acquisition



(4) Block-diagram of the recognition system

- Discretization of the rotational movement
- Conversion of photocurrent into data used in programming environnement
- Measuring the absorption spectrum with a spectrophotometer
- Vein segmentation through a camera mounted on the motor
- Multimodal recognition, biometric application

(5) Skin sample area used for each subject, as input of the acquisition system

Perspectives

- Improved system with a monochromator in order to have a great dimensionality as input of recognition data as well as higher accuracy for wide range of different data
- Maximized signal-to-noise ratio by minimizing standard deviation.
- Coupled system with a camera for a better clustering
- Adaptation for different application in different fields of study such as medical, cosmetology, computer graphics as well as biometrics.

(5) Fujitsu PalmSecure Palm Vein, biometric authentication device

(5) Sony's Smart Skin Evaluation Program, analyzing various elements of the skin

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