



A Method for Estimating Blood Flow Condition from Skin Tone Information in Real Face Images

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Education

Miku Shimizu



- **Doctoral student** 04/2023~
The University of Electro-Communications , Tokyo, Japan
Department of Informatics
- **Master of Engineering** 03/2023
The University of Electro-Communications , Tokyo, Japan
Department of Informatics
- **Bachelor of Engineering** 03/2021
The University of Electro-Communications , Tokyo, Japan
Management Science and Social Informatics Program

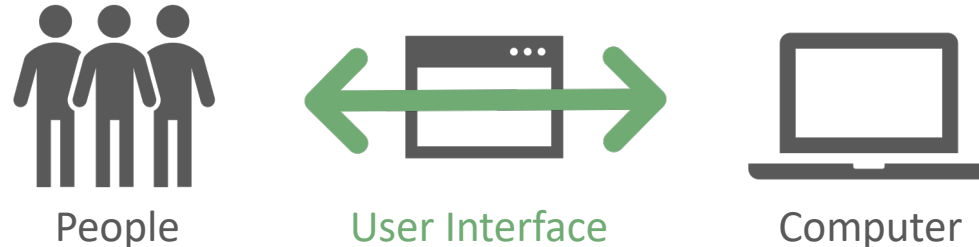
My laboratory topic

Itakura & Mizuno Lab

(The University of Electro-Communications)

Human computer interaction

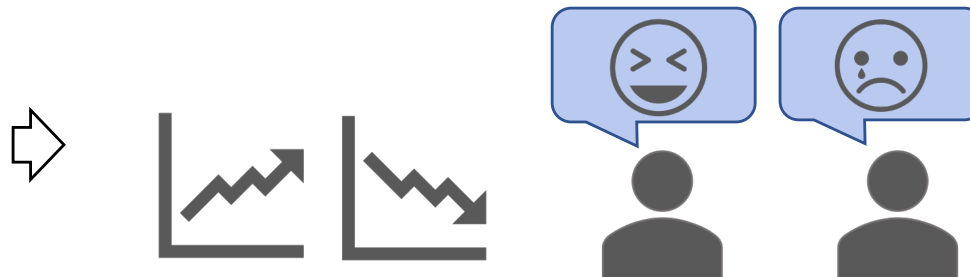
...Creating systems that use biometric information to make people more comfortable



My research expertise is Emotion estimation



Real face image



Stress and emotion estimation

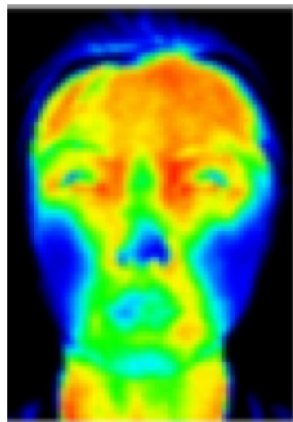
Background

Visualization of fatigue, stress → Quality of life ↑



Emotion and Stress Estimation Attention ↑

Previous study



Intermittent
Mental Work Load

Temperature changes associated with
nasal subcutaneous blood flow changes



Autonomic nervous activity
in peripheral blood vessels

Nasal skin temperature

Infrared Thermography

→ High price & Difficult to use easily



Background

Real face image → Autonomic nervous activity

Previous Study

Evaluation of autonomic nervous activity
→ **Subcutaneous blood flow changes**

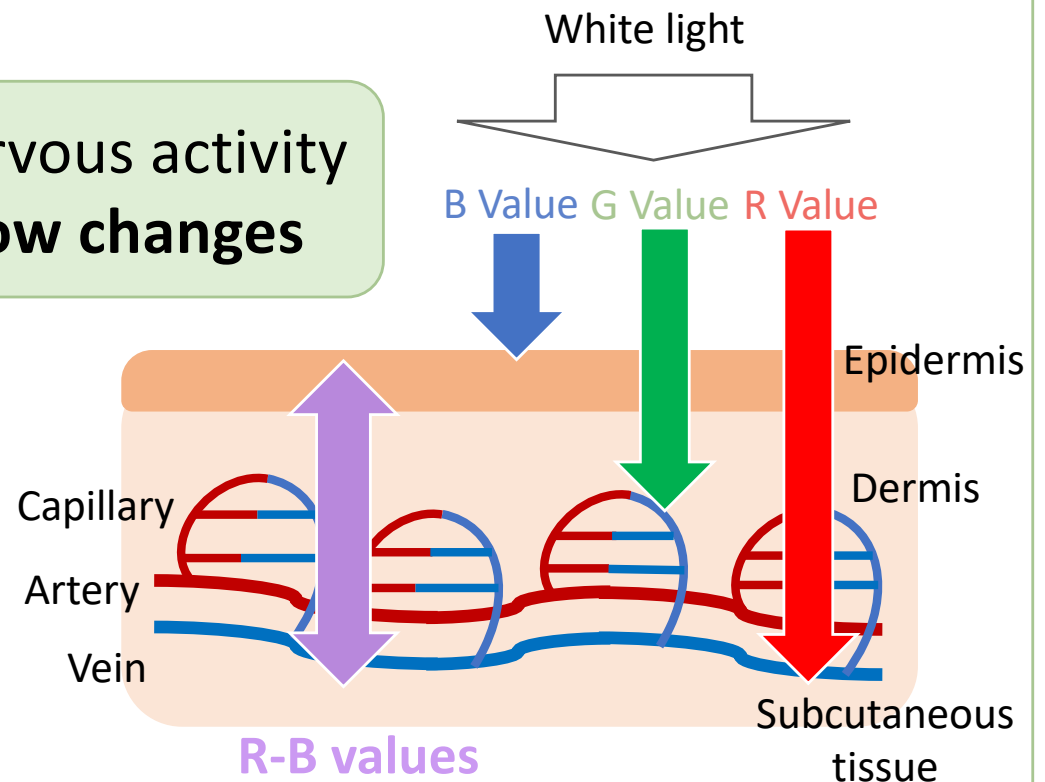
Penetration depth

Deepest : **R Value**

Shallowest : **B Value**



R-B values = Observe subcutaneous blood flow : **Broadest**

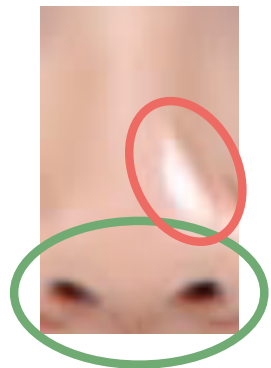


Background

Real face image → Autonomic nervous activity = Stress

Previous Study

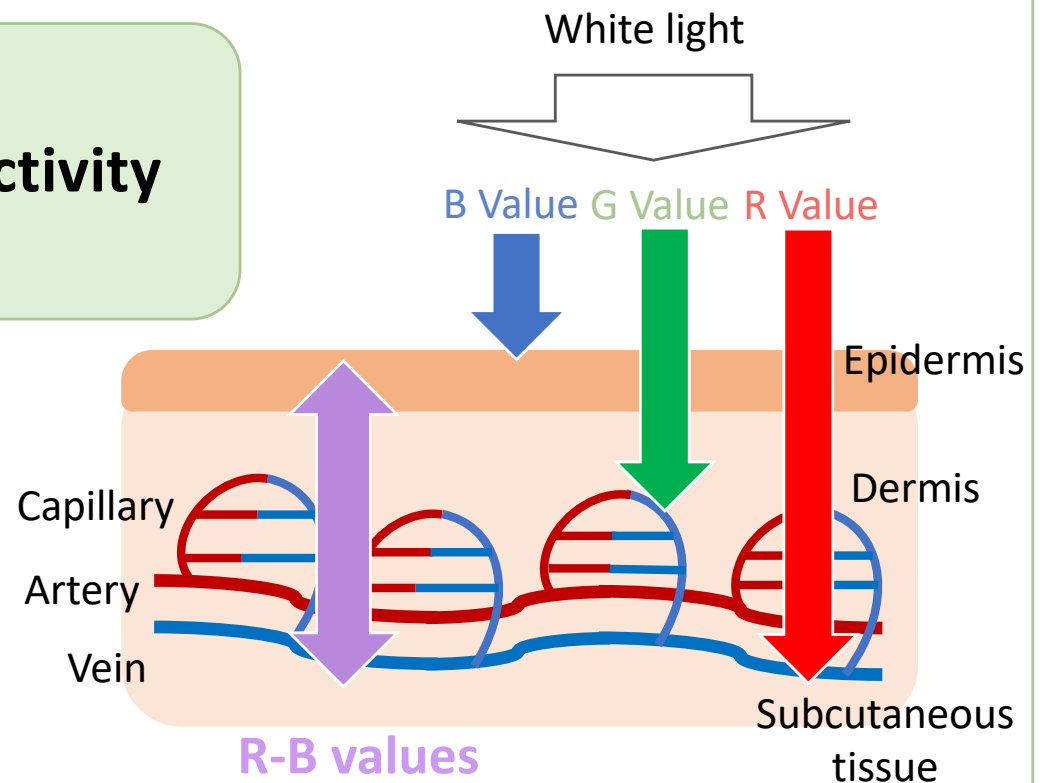
R-B values
= Autonomic nervous activity
evaluation index



Reflections and shadows due to unevenness

Nostrils

≠ Changes in blood flow



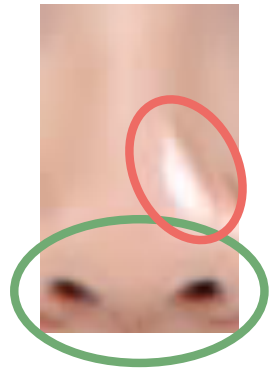
Necessity of removal

(Reference : Interface , 19, CQ Publisher, 2018/5.)

(Patent : Autonomic Nerve Activity Detection System, Autonomic nerve activity detection method and program , Miku Shimizu, Tota Mizuno, Naoaki Itakura Special application:2021-188255)

(Previous study1 : Evaluation of methods for estimating autonomic nervous activity using a web camera , Miku Shimizu, Yu Matsumoto, Naoaki Itakura, Kazuyuki Mito, Tota Mizuno Artificial Life and Robotics 2022)

Proposed Method

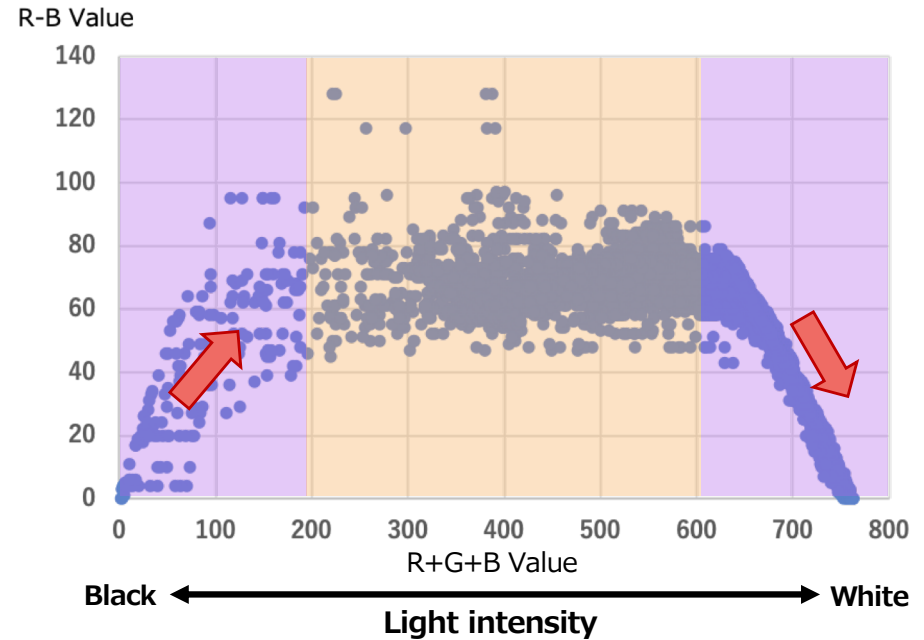


Reflections and shadows due to unevenness

Nostrils



Focus on the difference in color from the skin



R+G+B Value = Black(shadows)
White(reflections)

Slope is **big**



Characteristics distribution

use

Narrowing the focus range



Possibility to identify a range where the effect of light intensity is small

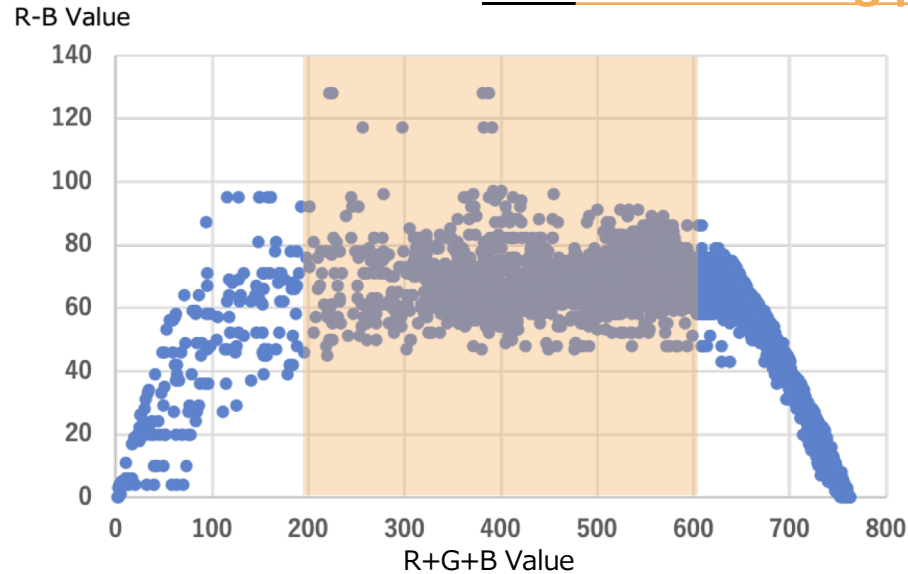
Pixels corresponding to the purple area were filled



Are all remaining pixels blood flow changes?

Proposed Method

Are all remaining pixels blood flow changes?



In this area,

Large changes in distribution when blood flow changes occur



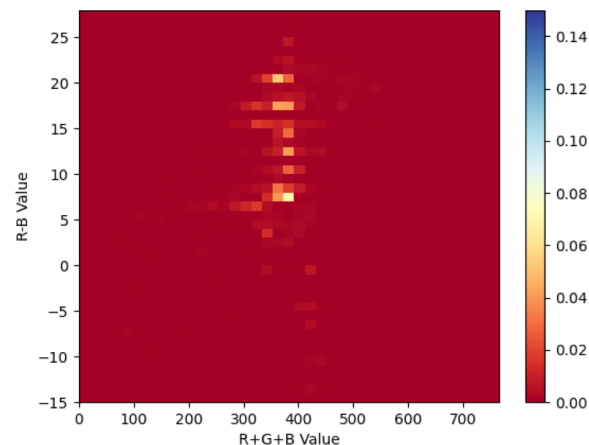
Pixels representing blood flow changes



Use heatmap

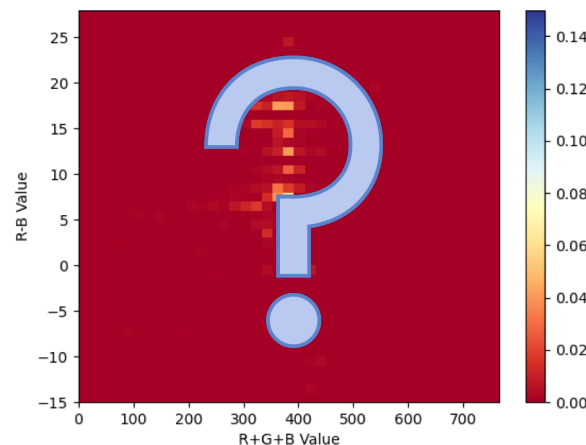
Visual representation of which areas have more pixels

Before



Blood flow changes

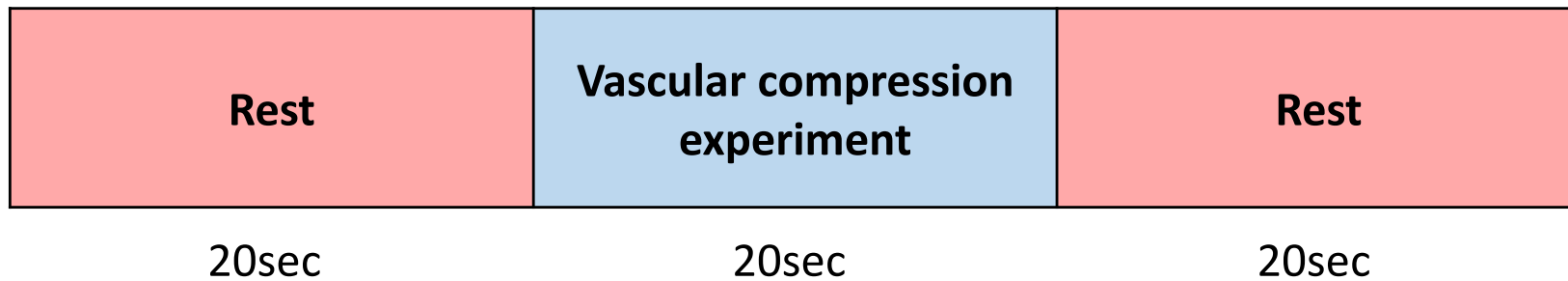
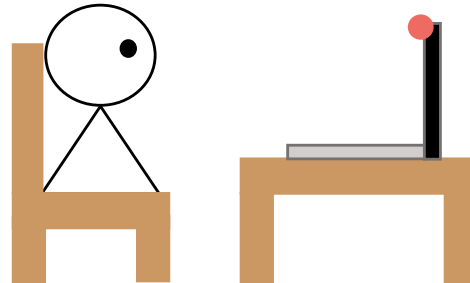
After



Focus on what changes are occurring

Experiment

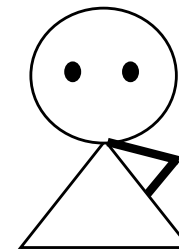
Web camera
→ Real face image



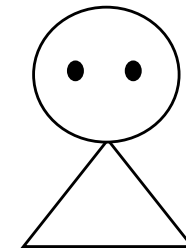
Experimental motion

Ask the subjects to lightly suppress the carotid artery themselves

Vascular compression



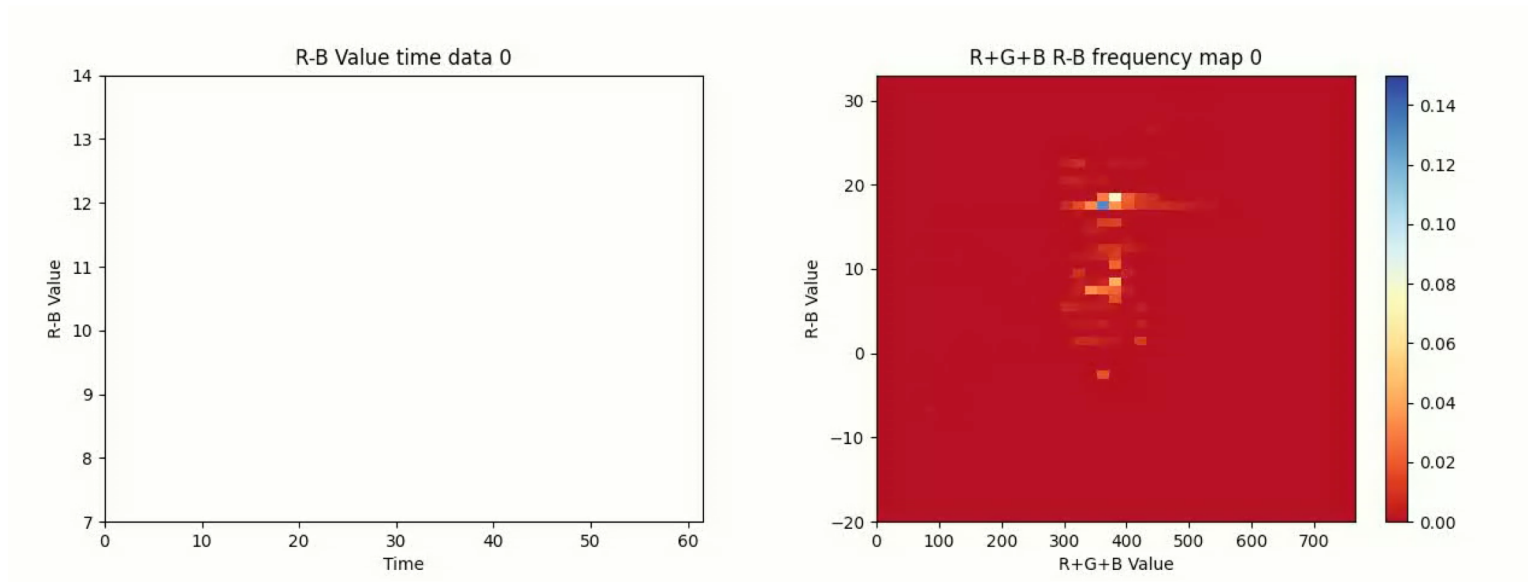
Rest



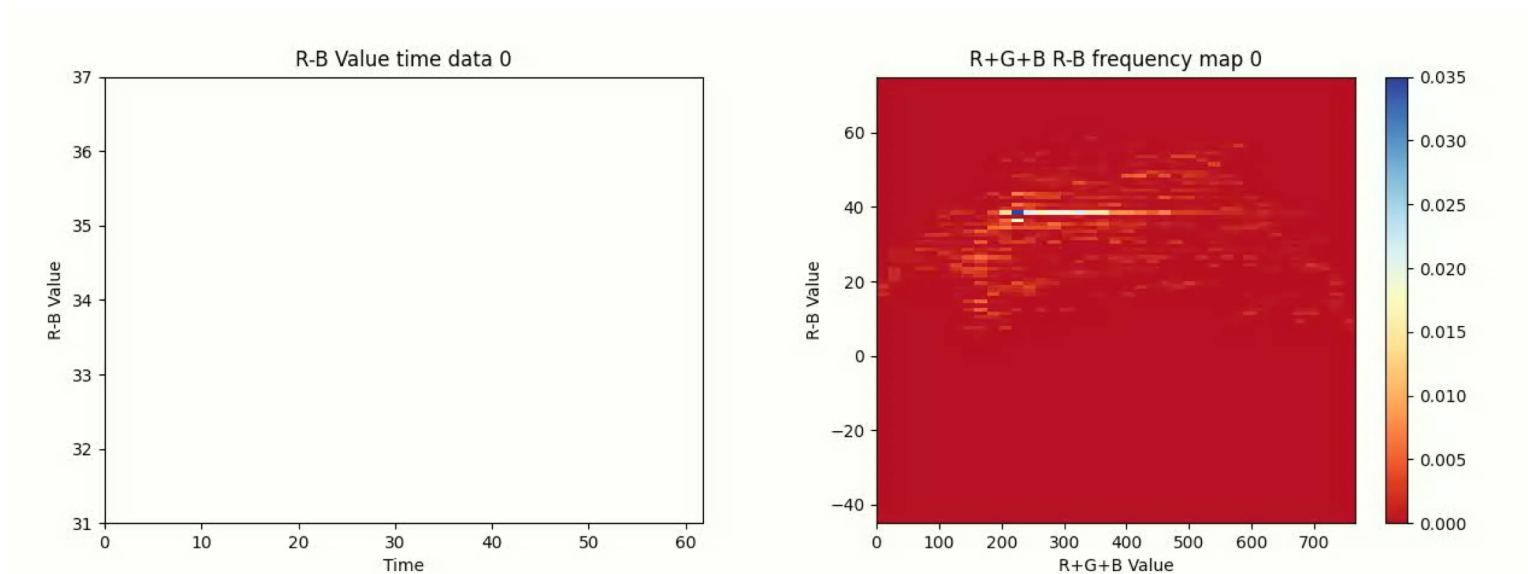
Result

Rest 20sec	Vascular compression experiment 20sec	Rest 20sec
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Subject A



Subject B



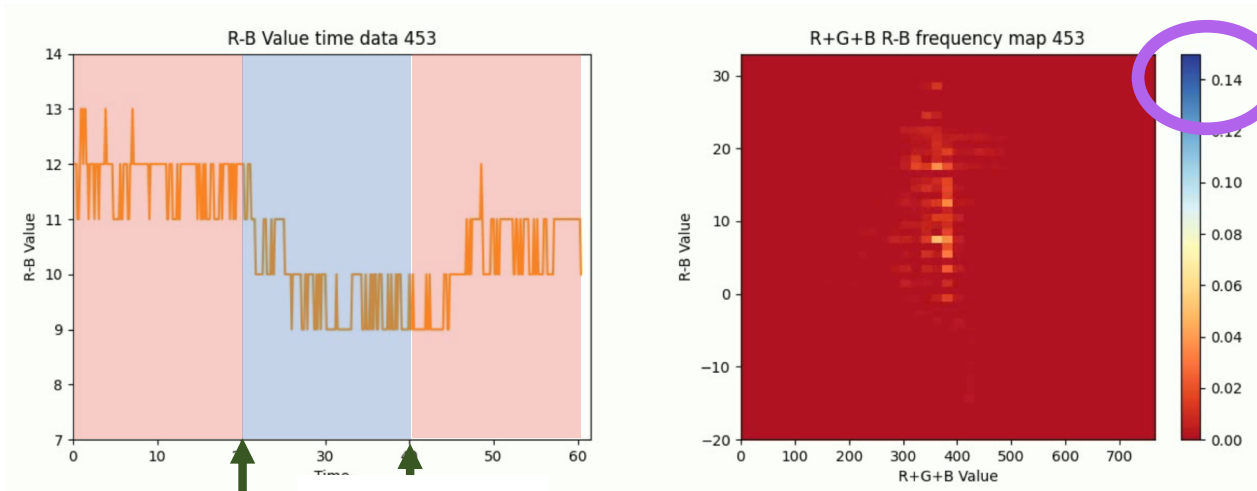
Result

Rest 20sec	Vascular compression experiment 20sec	Rest 20sec
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Vascular
compression

Compression
release

Subject A



Both subjects

Vascular compression

→ R-B component value ↓

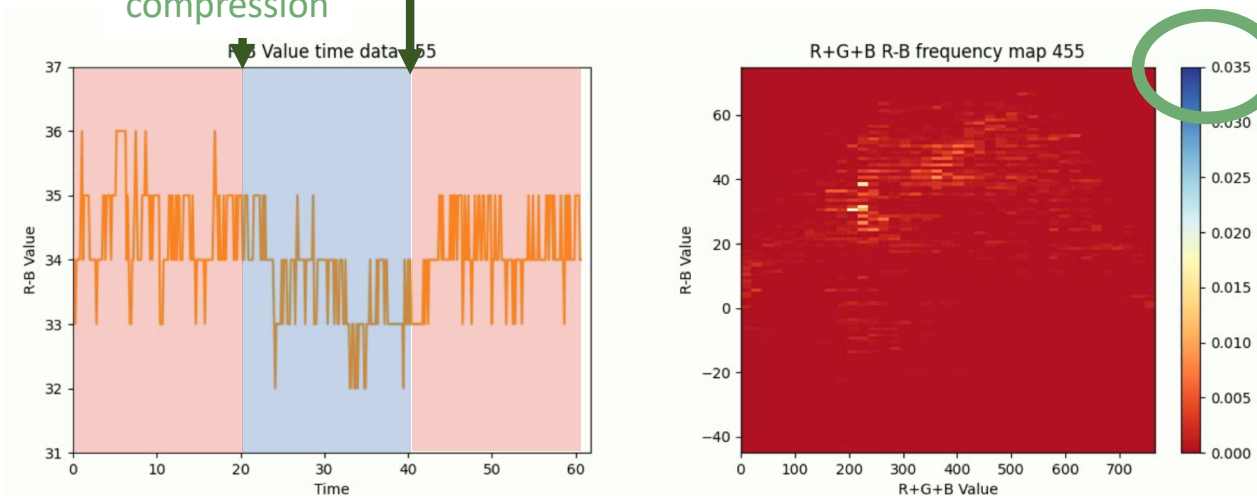
Compression release

→ R-B component value ↑

R-B component value
= Blood flow change

Vascular compression
Compression release

Subject B



Subject A

Vertically dense

Subject B

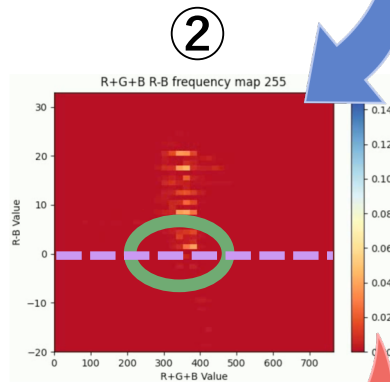
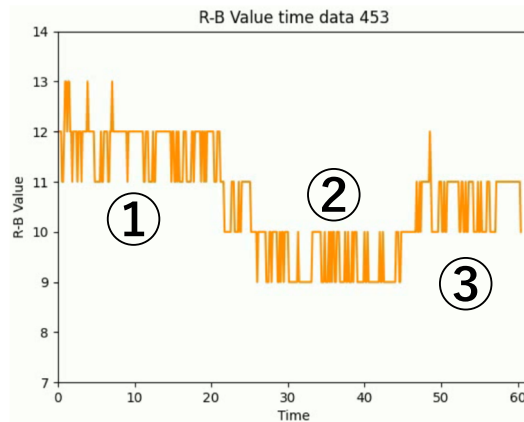
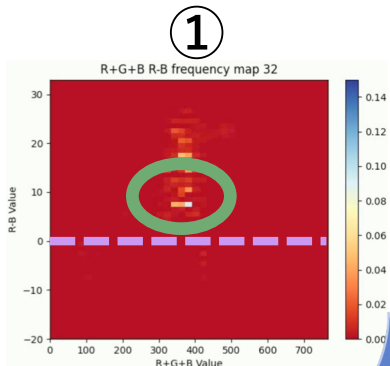
Scattering both vertically
and horizontally

Discussion

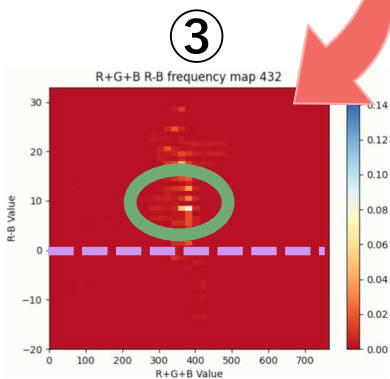
----- : 0 line of R-B Value

Subject A

Vertically dense



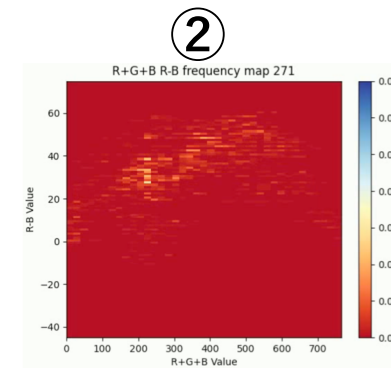
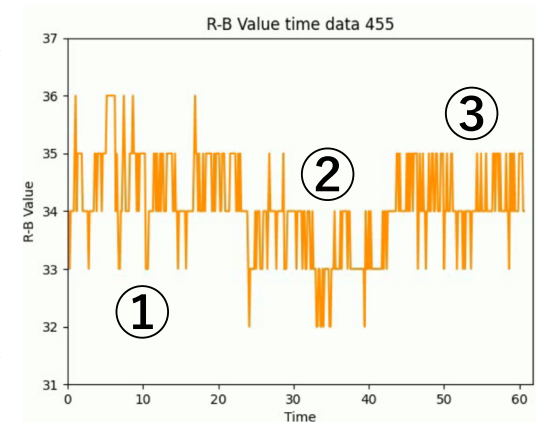
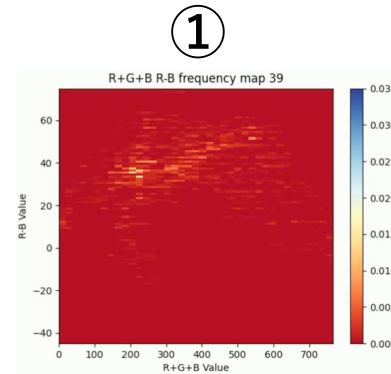
Vascular compression(①②)
 • R+G+B values unchanged
 • Only the dense distribution goes down



Compression release(②③)
 • R+G+B values unchanged
 • Only the dense distribution goes up

Subject B

Scattering both vertically and horizontally



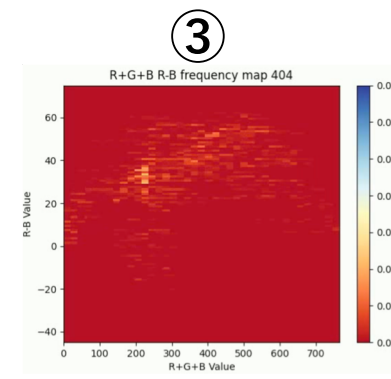
Distribution is spreading



Vascular compression/release



Overall distribution variation occurs



No change in distribution trend

Summary

Propose : Devise a method to quantitatively remove the effect of light intensity and acquire only blood flow changes

Method : Clarify the distribution and characteristics of pixels corresponding to the nose by creating **heat maps**

Result : Take a distribution with **individual differences** among subjects

In the future : Seek ways to deal with the high impact of individual differences
→ Consider variation in more detail