

Development of Healthcare Agent System

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 - Photo-plethysmography & Vital signs
 - Pulse sensor modules using LED/PD
 - 'Symbiotic' Healthcare Agent System
 - Demonstrations; Questionnaire & Amusing game
 - Conclusion



Finger plethysmograph sensor

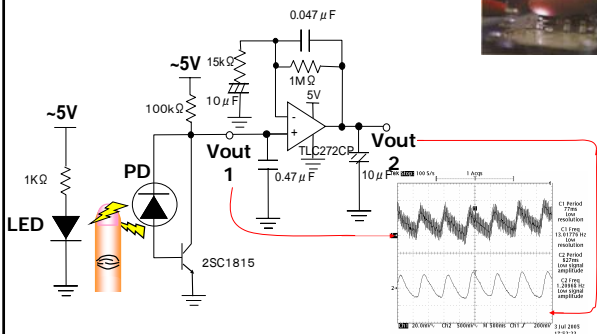
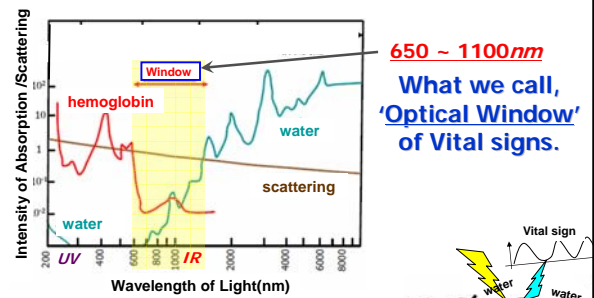


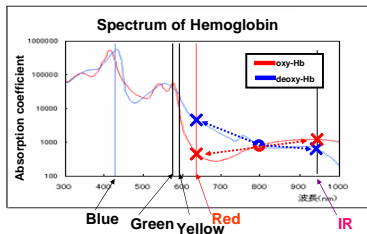
Photo-plethysmography measures 'pulse' waves.

Photo-plethysmography



When light enters body, moderate absorption occurs in both blood and water(=body), then light is reflected or transversed.

Therefore, various vital signs are acquired.

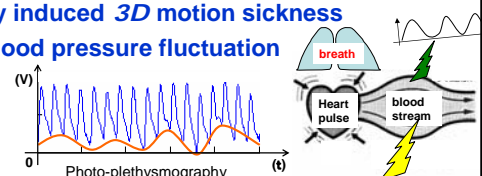


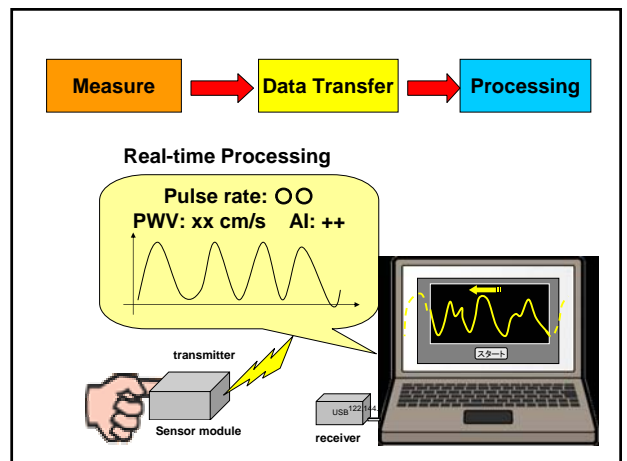
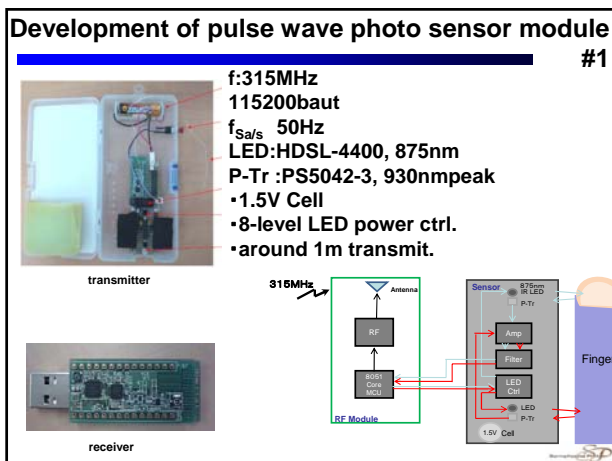
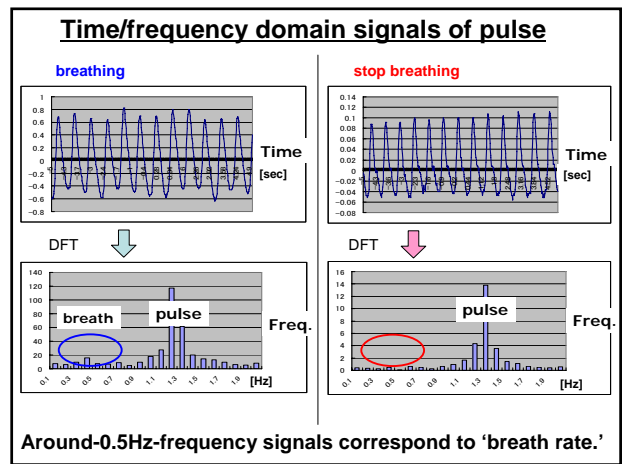
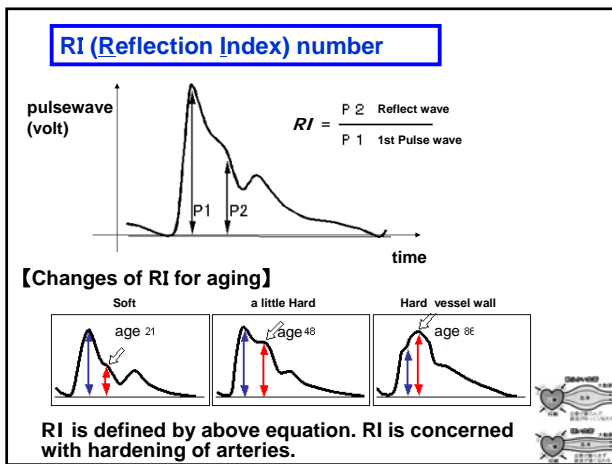
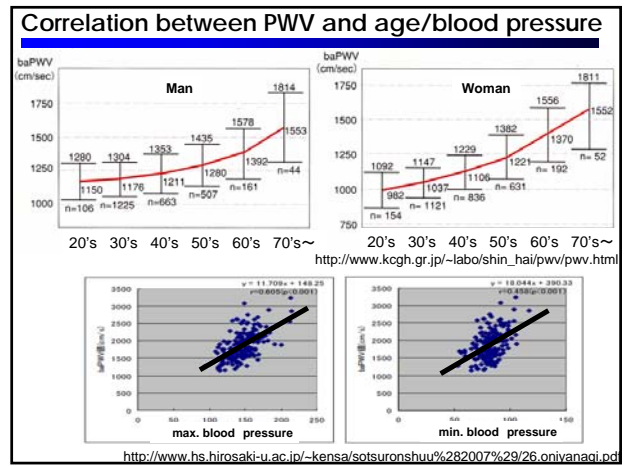
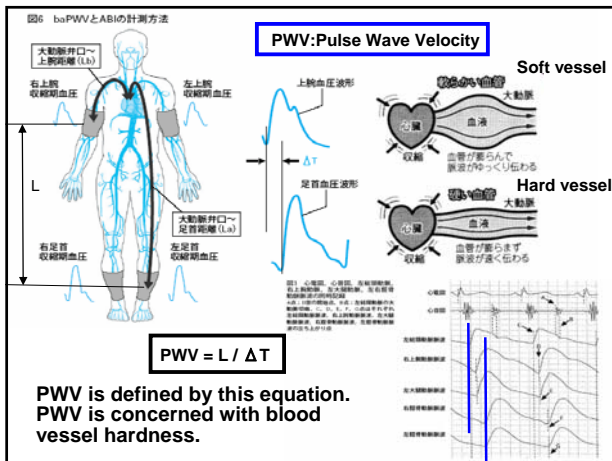
Pulse Oximeter

Pulse Oximeter, which measures oxygen saturation in blood by using both IR and red light, has been invented by Aoyagi, Nihon-Koden, JAPAN, in 1974.

Vital signs from pulse wave

- + pulse/heart beat rate
- + oxygen saturation(SpO₂)
- + PWV ; Pulse Wave Velocity
 - ~ blood vessel hardness, blood pressure
- + RI : Reflection Index ~hardening of arteries
- + respiratory/breathing rate ~ SAS
- + visually induced 3D motion sickness
- + daily blood pressure fluctuation
- ...
- etc.





Proto-type #1: Pulse sensor module

315MHz Transmitter

receiver USB PC

MCU, A/D, LFP, センサデバイス

Real-time pulse wave acquisition has been successfully realized.

Proto-type #2: Improvement of module #1

315MHz Transmitter

receiver USB PC

MCU, A/D, LFP, センサデバイス

315MHz/ short length transmit. Short life, Large size.

3 type of RF available

2.4GHz W-LAN

2.4GHz Bluetooth

2.4GHz ZigBee

receiver USB PC

MCU, A/D, LFP, センサデバイス

Type#1

Type#2

The improved module#2 has;
3-Type of 2.4GHz RF availability, and...

Proto-type #2: Improved sensor module

36mm

35mm

25mm

13mm

4hr. continuous use

transmit. 21.3m(direct)

Li-ion batt.

rechargeable with USB cable

- Compact Multi-layer PCB assemble (size:W36xD35xH23mm)
- Rechargeable Li-ion battery/long life
- Long transmission distance

Module #2: Developed sensor module

W36 x D35 x H23mm

Wrist-band/Finger-stall Type

Compact wearable pulse sensor module

Not only wristband-type, but various sensor modules have been successfully implemented for the next healthcare system.

Hardware Implement of "Pulse mouse"

Photo pulse sensor

Amp., filter, MPU

Li ion batt.

Bluetooth

Beyond 'Ubiquitous'..... *Data everywhere, but*

A lot of "Ubiquitous healthcare systems" have been developed nowadays. However, "healthcare" doesn't tend to last for a long time. Most of us cannot continue our 'daily healthcare,'

Because of;
troublesome, complicated, boring, invisible results, expensive (for no sickness), ...

'Beyond Ubiquitous'; **'Symbiotic' healthcare System**

Symbiotic: human-friendly machine/system/society by NEC corp., Japan

- Symbiotic system will... help us positively, even for those who are *not*-friendly with machine.
- Our **Symbiotic Healthcare System** here, features...
 - + Positive healthcare support from system side.
 - + Unconscious measurement for daily healthcare. = No tension/stress, Raw vital signs
 - + Something like amusement game to promote & keep up daily health-monitoring.

Tension → Higher pressure value as compared with that at home

Pulse Sensor Mouse

LED/PP pulse sensor

Measurement of pulse with LED sensor mouse during normal PC operation / = Unconscious measurement !
Only using PC mouse normally, pulse signal can be sensed unconsciously. --> Healthcare

'Symbiotic' needs Healthcare 'Agent'

input: Vital signals from sensor

Healthcare Agent

- data processing
- analysis/management
- sensor control

output: health data records, management indication, healthcare advice

Pulse rate: ○○
PWV: xx cm/s
RI: ++
How well? You have a little fever.

Healthcare Agent acts instead of users:

• Healthcare agent system:

control, vital sign acq., Data transfer, PC, Database/Cloud, Application, sensor

• User's viewpoint: Since agent acts instead of users, User is unconscious of measurement.

Operation, Advice

User can get advices on health during normal PC operation only.

Concept of Healthcare Agent System

measure, advise, transfer, DB, Healthcare agent

You're fine today! Yesterday your data was ...

Please hold strongly, and try again.

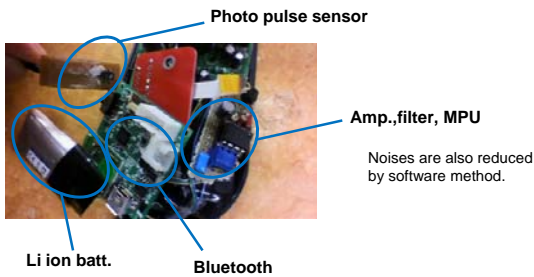
Hardware Implement

Li ion batt., Mouse board, RF board, Photo pulse sensor

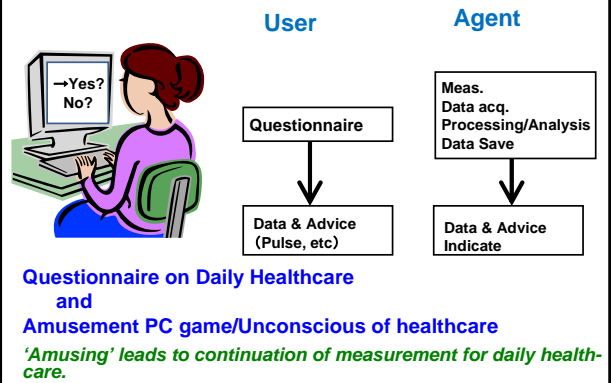
Popular Optical mouse
光学式ワイヤレスマウス
インターフェイス:USB
電波周波数:27MHz帯
サイズ:58.2(幅)×98.4(奥)×35.4(高)mm
通信距離:1m
Developed Sensor&RF
通信方式:Bluetooth(2.4GHz)
通信距離:21.3m
サイズ:36(幅)×35(奥)×23(高)
ボーレート:9600baud
サンプリング周波数:50Hz

Sensor

Hardware Implement of Pulse Mouse



Software Development



Software application for 'Symbiotic'



Application Demo. #1



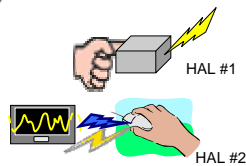
Healthcare agent system;

has been developed to aim for 'symbiotic' society.

Ubiquitous Healthcare System

- Photo-plethysmography sensor using LED/PD
- 'Symbiotic' Sensor Agent Systems

Healthcare Agent

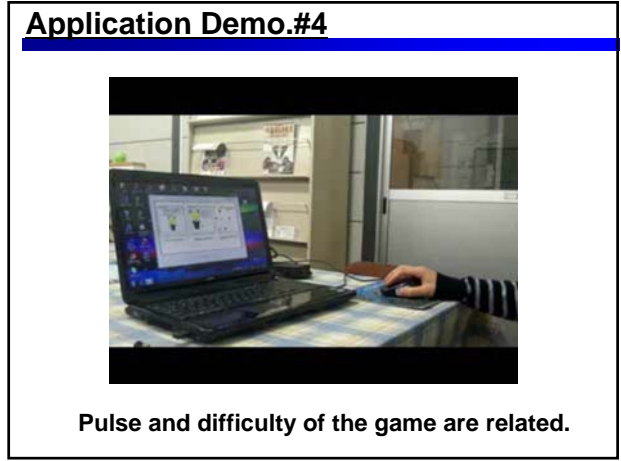
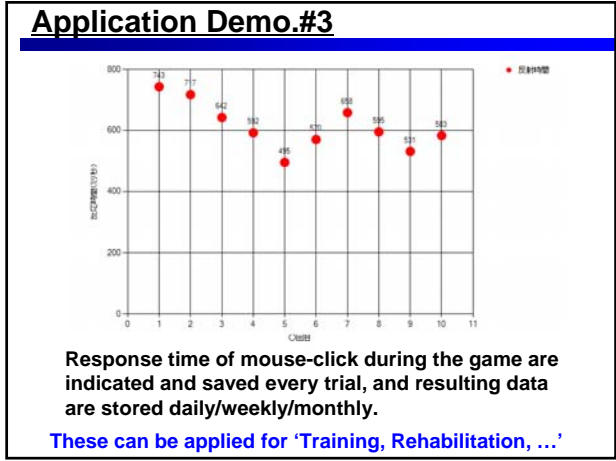
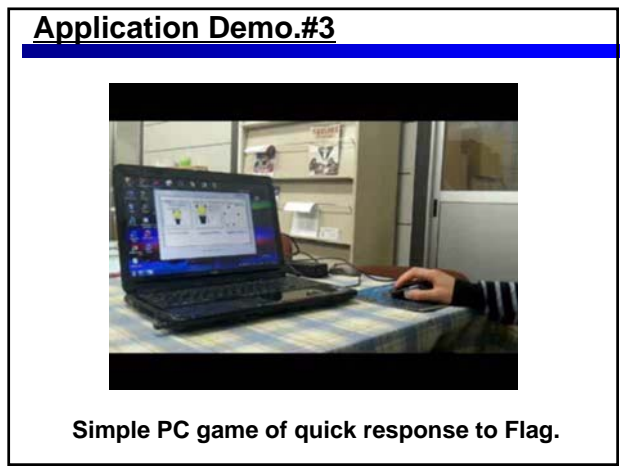
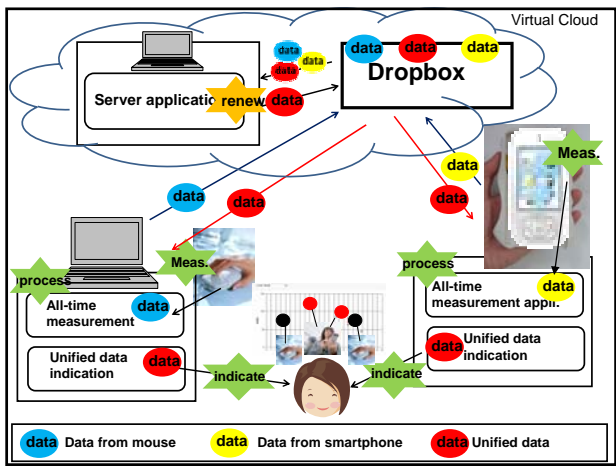
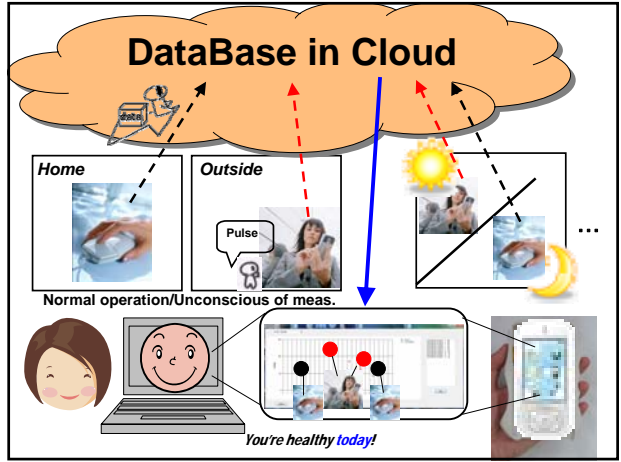


'HAL' (Healthcare Agent Lavalier)

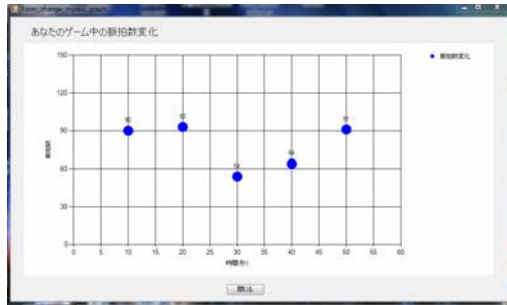
HAL #3: Smartphone Gadget (resin)



HAL #4: Portable Game (Nintendo 3DS)



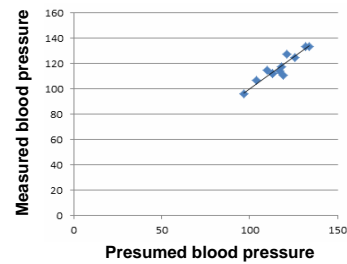
Application Demo.#4



Pulse counts during the game are indicated.

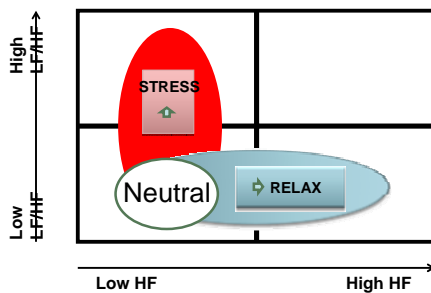
'Amusement' is considered to be useful for 'motive force' of continuation of daily healthcare.

More vital signs; Presumption of blood pressure;



Blood pressure is presumed by several vital signs (such as pulse, RI, ... etc.) obtained from photo-plethysmograph pulse wave, because they are closely related each other.

More vital signs; Presumption of 3D motion sickness



Frequency spectrum of pulse wave especially at 0.04-0.15Hz(LF) and 0.15-0.40Hz(HF), are closely related to our 'Stress' and 'Relax.'

Conclusion

➔ Healthcare Agent System

- Photo-plethysmograph LED sensor module has been implemented.
- 'Symbiotic' healthcare agent system has been developed aiming for;
 - + positive healthcare support / anytime, anywhere
 - + unconscious measurement
- Several interactive applications have been demonstrated.

Progressing subjects & problems to be solved;

- More vital data mining from pulse signal and prompt suitable advices based on the data
- Data security and user identification

Thank you for your attention.

