Unconstraint Measurement of Vital Information Using Near-Infrared Light Sensor

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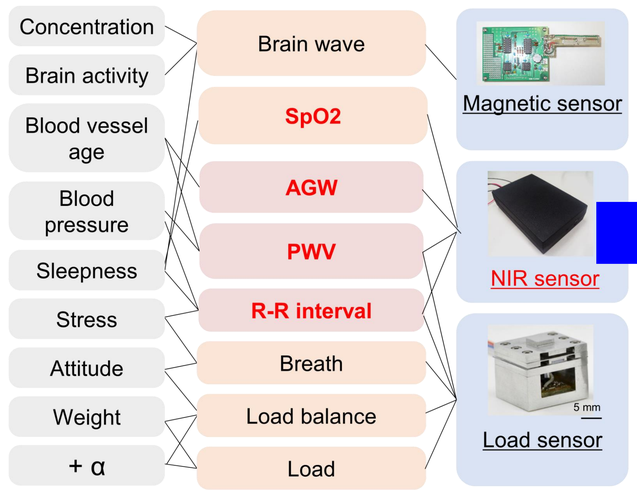
Casual sensing of pulse wave information!!

Background

Aged society

Lifelogging is important



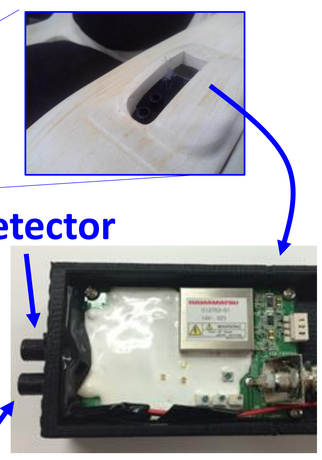
Commercial NIR sensor	 EPSON, PS-100BL http://www.epson.jp/technology/engineer/pulse_sensing.htm	 GS-1A http://www.koike-medical.co.jp/products/detail.php?product_id=116
Method	Constraint	Constraint
Accuracy	HBR: ±2 %	HBR:±2 %

Unconstraint lifelog is needed.

Concept

Unconstraint NIR sensor

Smart chair



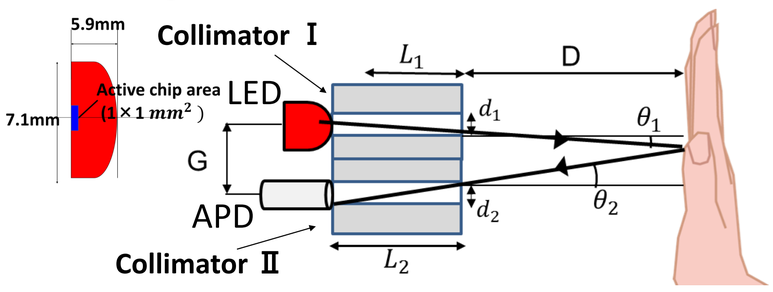
NIR sensor

Specification of NIR sensor

LED: 805 nm,50mw
PD: APD (Hamamatsu Photonics) C12703-01
Installing the visible light cut filter in front of APD

Reduction mechanism of refractive light

Configuration of collimator



$$D = \frac{G - \frac{1}{2}(d_1 + d_2)}{\tan\theta_1 + \tan\theta_2}$$

$$\tan\theta_1 = \frac{\frac{1}{2}d_1 + 0.5}{L_1 + 5.9} \quad \tan\theta_2 = \frac{d_2}{L_2}$$

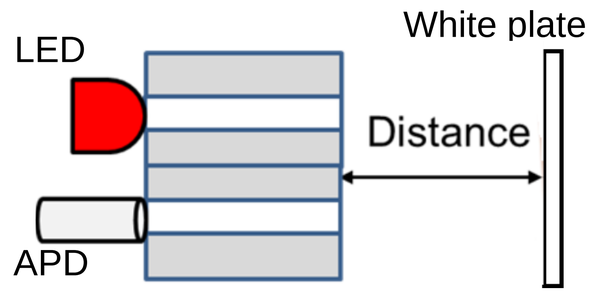
G : 12 mm
d_1: 5 mm
d_2: 4 mm
L_1, L_2:15mm

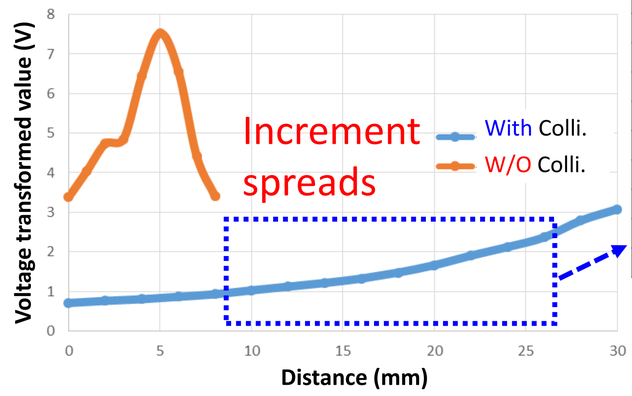
D : 18.3 mm

D: Removable distance of reflected light
G: Gap between the collimator Ⅰ and the collimator Ⅱ.
d: Inner diameter of collimator
θ: Light spread angle from collimator

Experiments

Collimator evaluation





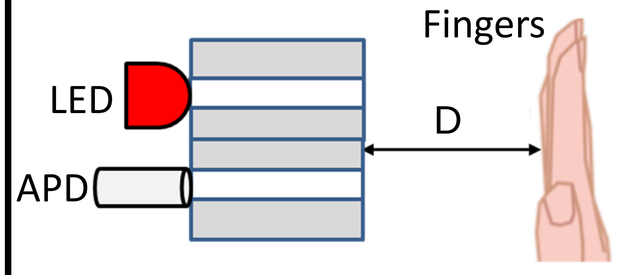
Relationship between distance and receiving refractive light

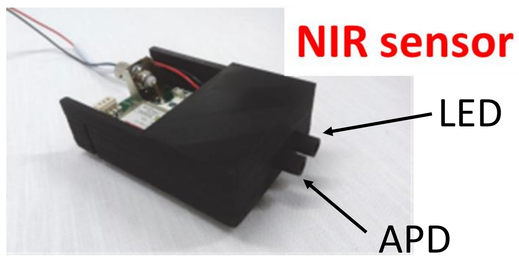
Distance (mm)	Voltage (V)
8	0.93
10	1.03
12	1.12
14	1.21
16	1.32
18	1.48
20	1.66
22	1.91
24	2.12
26	2.37

Refractive light was Increased from the Designed length (18 mm).

Reduction of Refractive light was achieved by using collimator.

Unconstraint measurement



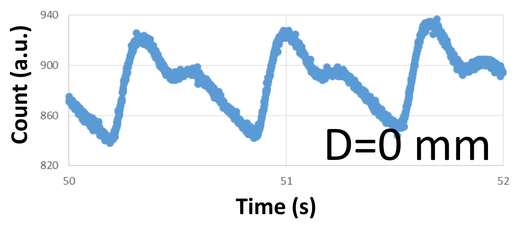


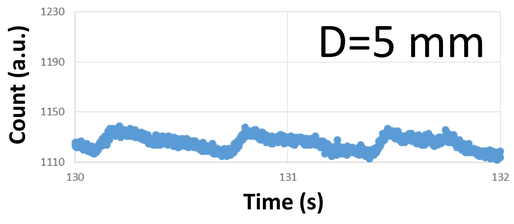
Reference sensor

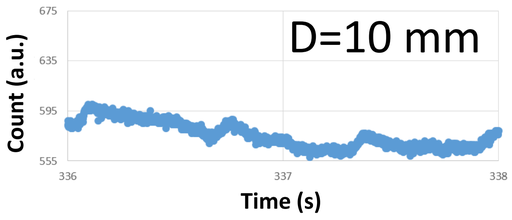
Arttet C
(Umedica. Co.ltd)

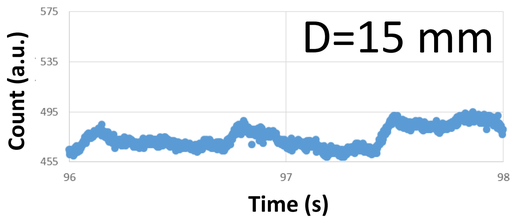
Result of pulse measurement

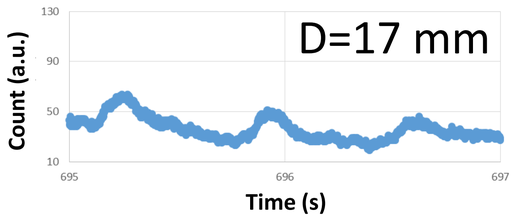
Experiment Condition
Sampling time: 1 ms
NIR sensor: Index finger
Reference sensor: Middle finger
D : Measurement distance











	HBR(bpm)		LF/HF			
Distance	NIRS	Ref	LF	HF	LF/HF	Ref LF/HF
0	88.7	89.1	1.70E-04	1.40E-04	1.22	1.096
5	95	94.3	3.00E-04	1.25E-03	0.24	3.37
10	89.8	89.4	3.99E-04	2.54E-03	0.157	2.463
15	86.7	87.3	1.40E-03	4.12E-03	0.34	1.884
17	※84.3	89.2	4.19E-03	1.15E-02	0.364	3.008

※Error of the commercial sensor : ±2%

LF/HF(Autonomic nerve activity balance)
Frequency of interval a-a
・0.05-0.15Hz：LF Sympathetic nerve function
・0.15-0.40Hz：HF Parasympathetic nerve function
Fatigue and stress degree

Conclusion

・We fabricated unconstraint near-Infrared sensor for casual sensing of vital information.
・Non-contact pulse measurement using NIR sensor was achieved (Distance: 15 mm.).
・It is necessary to improve precision, and to aim at more casual sensing.

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