



Le Quy Don Technical University
Department of Microprocessor engineering

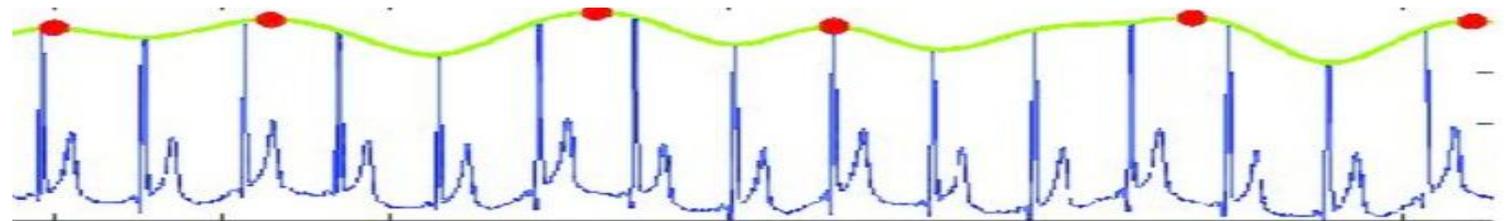


HealthCare

Non-contact Vital Sign Monitoring for Smart Healthcare System

Hoang Thi Yen

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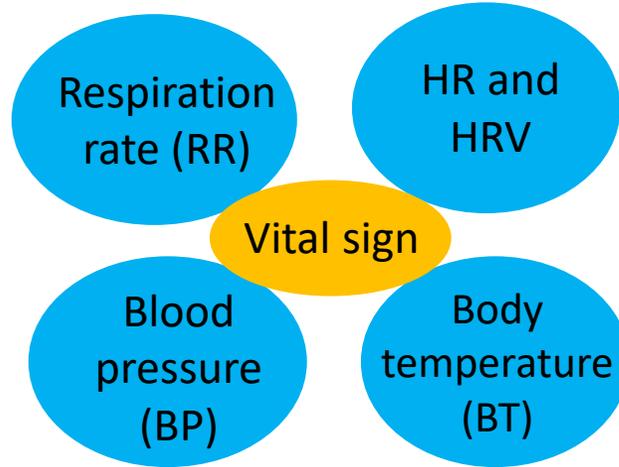


Conference for young researchers
24/4/2025

Outline

- 1 Introduction
- 2 Why non-contact sensing
- 3 Our contribution
- 4 Future potential

Introduction



HR: Heart rate
HRV: Heart rate variability

Traditional contact-method measurements have some limitation

- Uncomfortable
- Not suitable for long term monitoring
- Some device have burdensome system
- Not suitable for pandemic circumstance

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Introduction

2

Why non-contact sensing

3

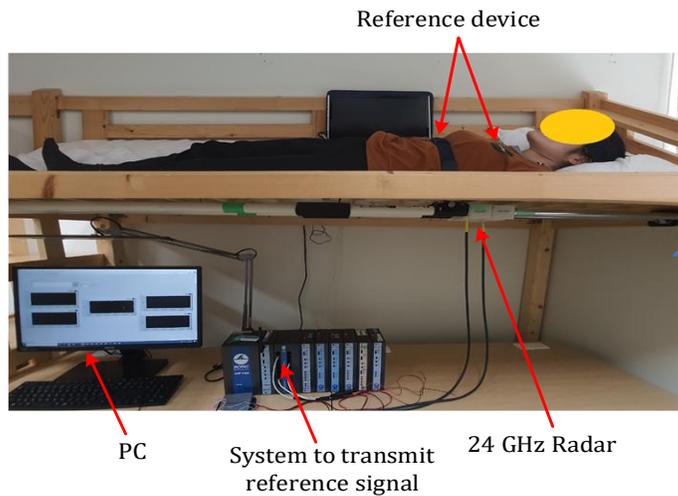
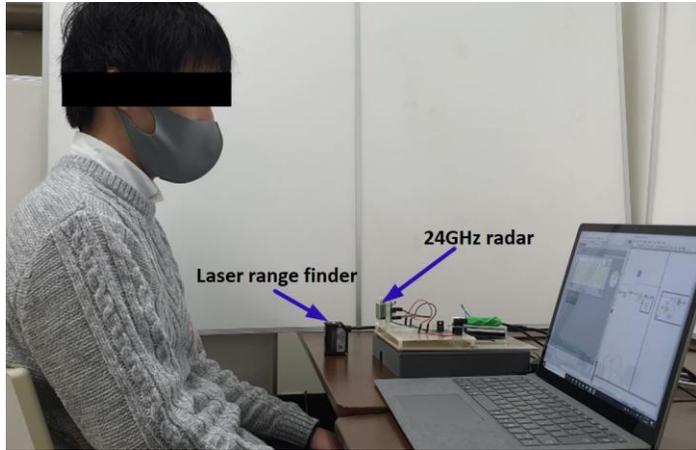
Our contribution

4

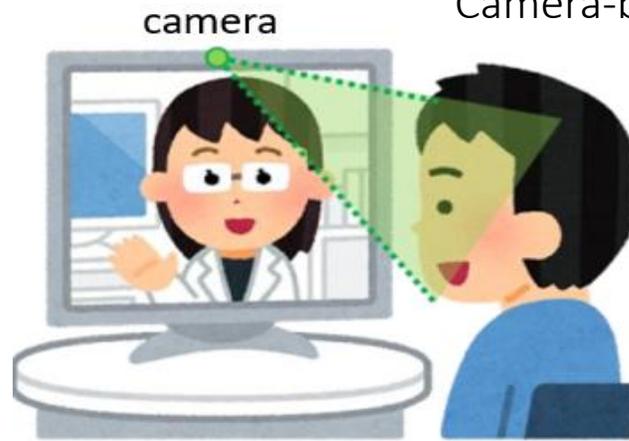
Future potential

Why non-contact sensor

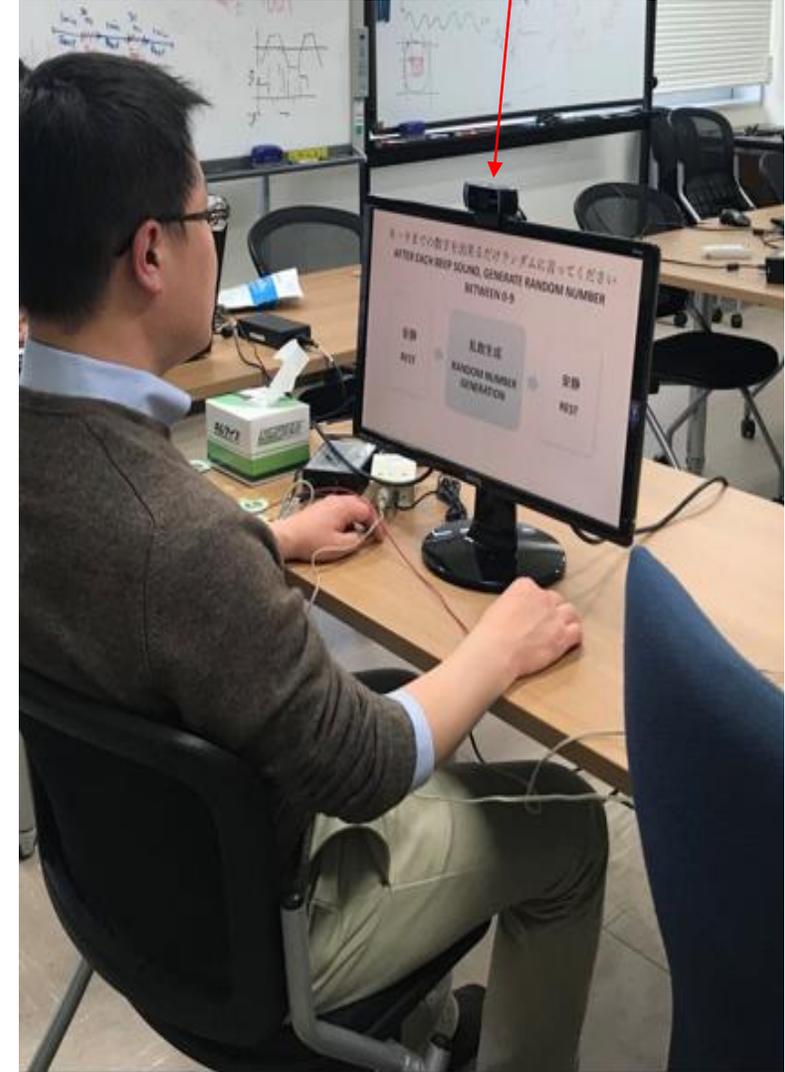
Radar-based



Camera-based

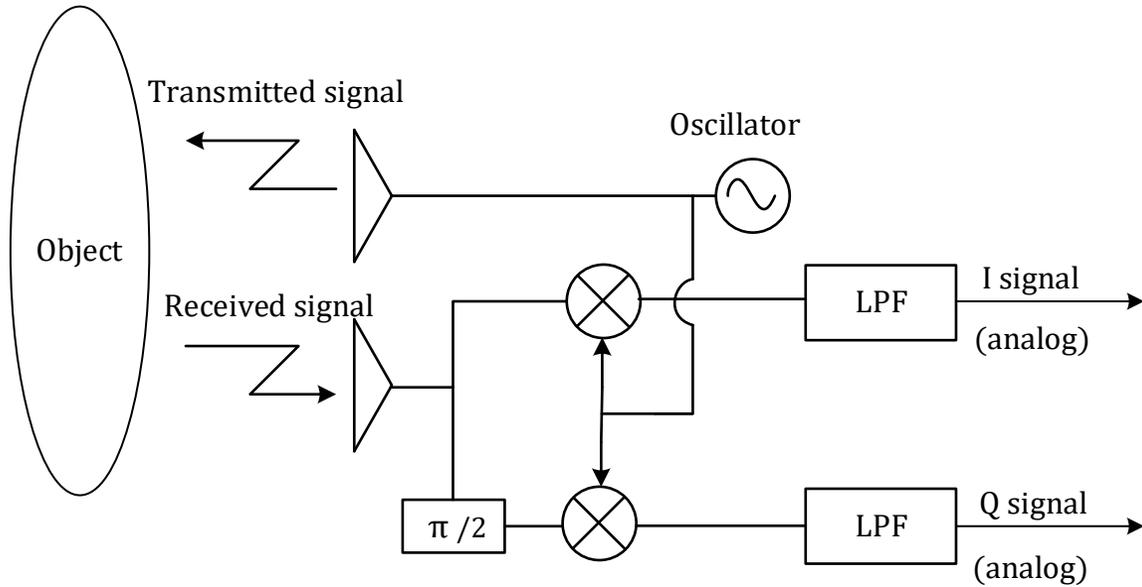


camera

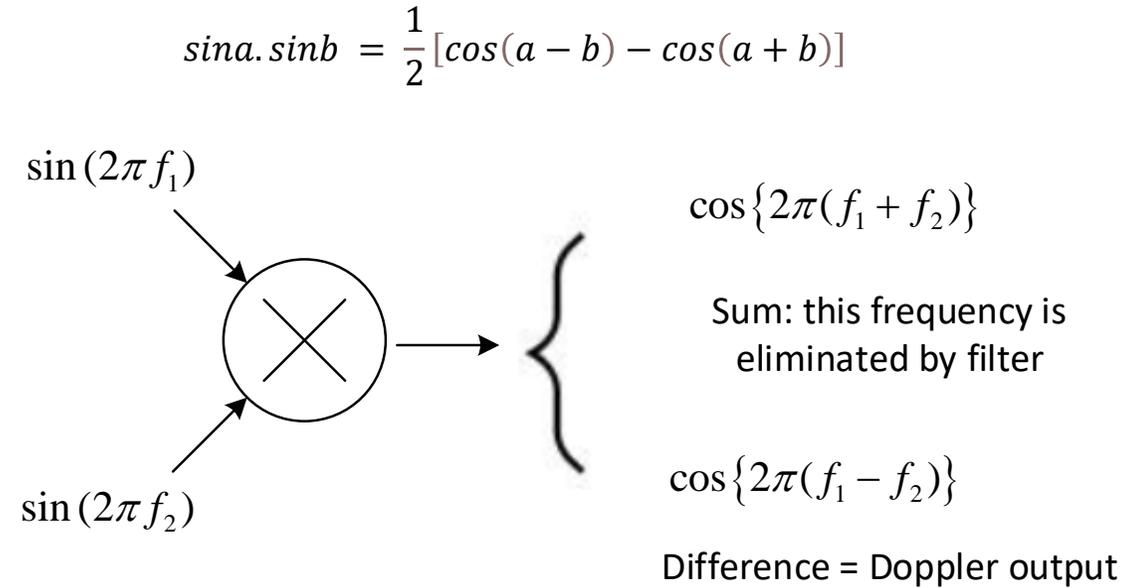


- ✓ Do not require to contact with subjects.
- ✓ Contactless, compact.

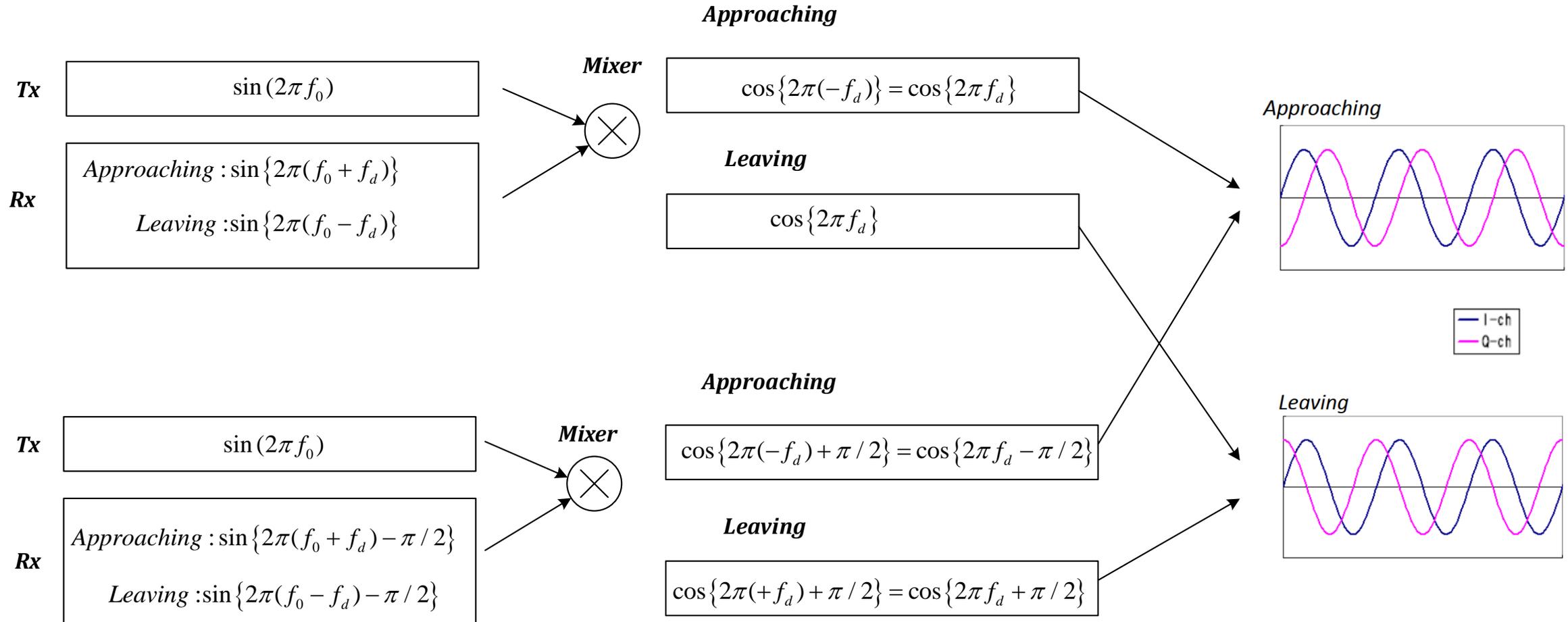
Continuous wave radar based



Structure of CW Doppler radar

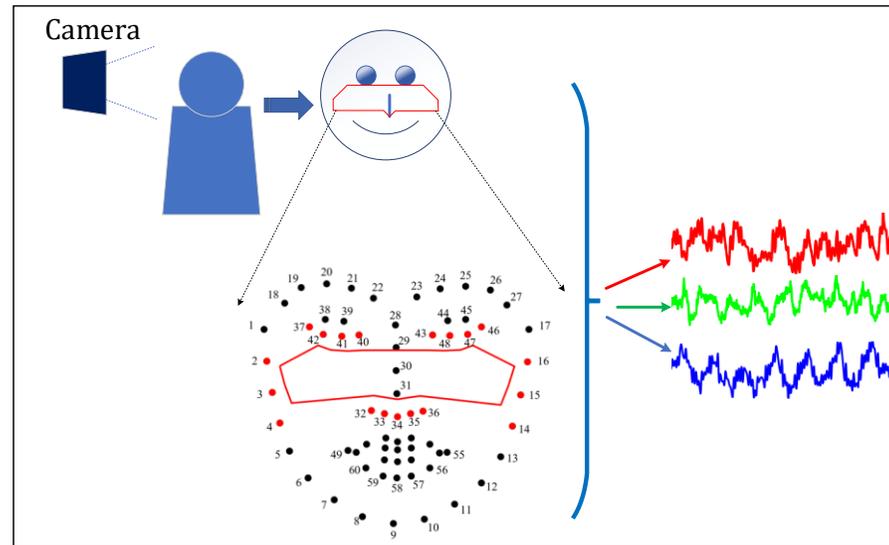
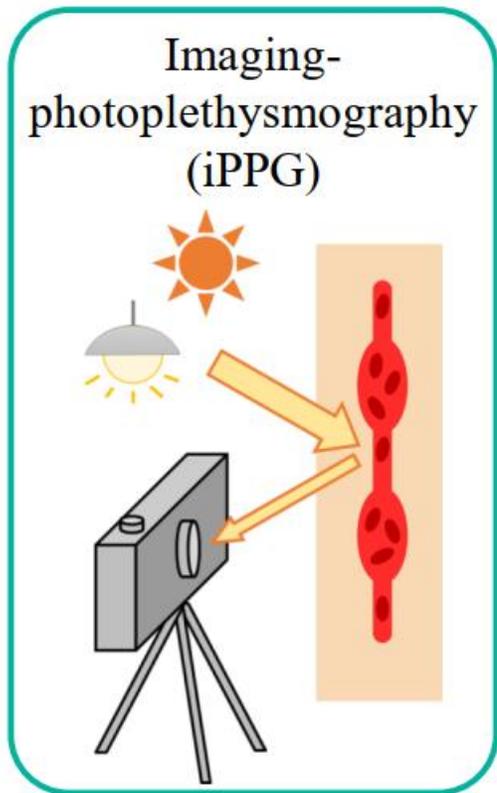


Continuous wave radar based

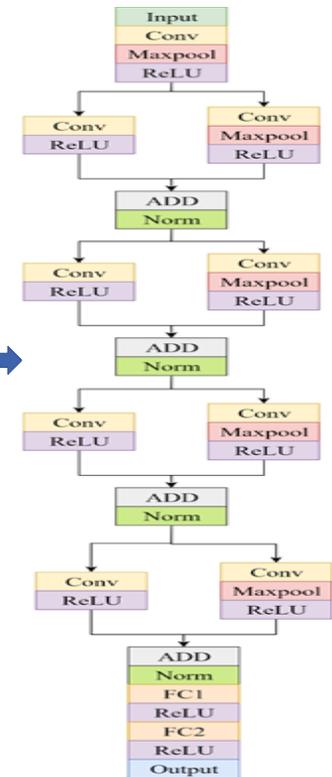
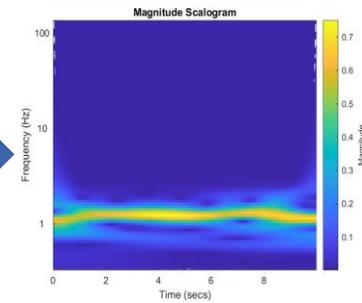


Doppler radar principle of receiving baseband signal

Camera-based



CWT



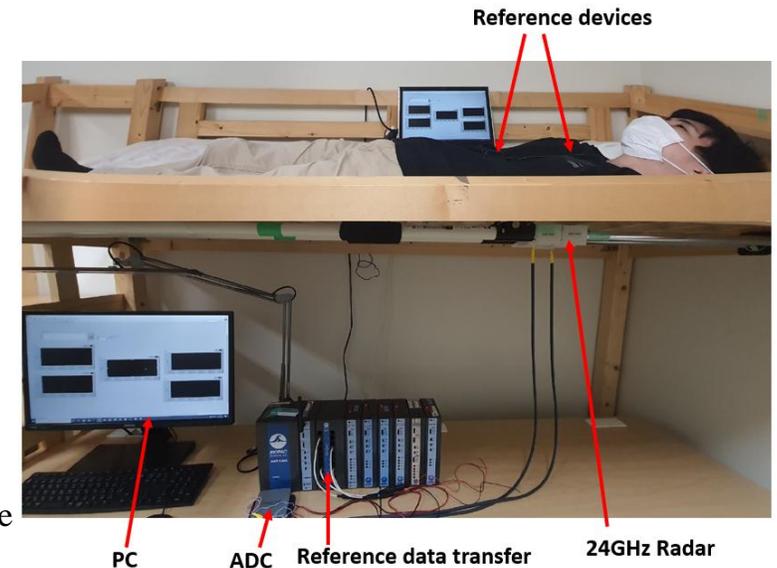
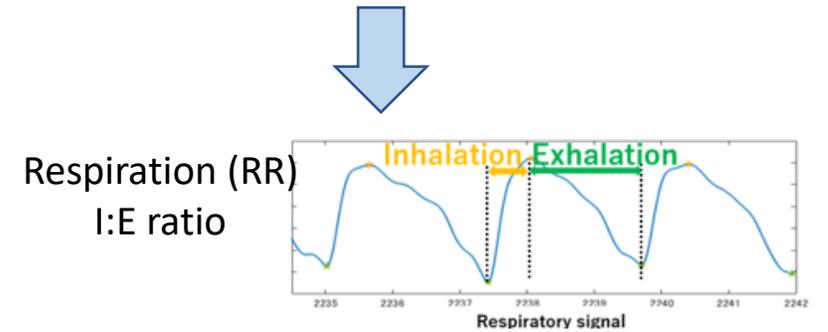
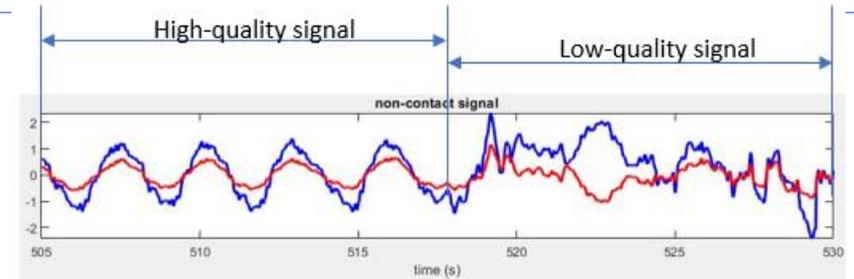
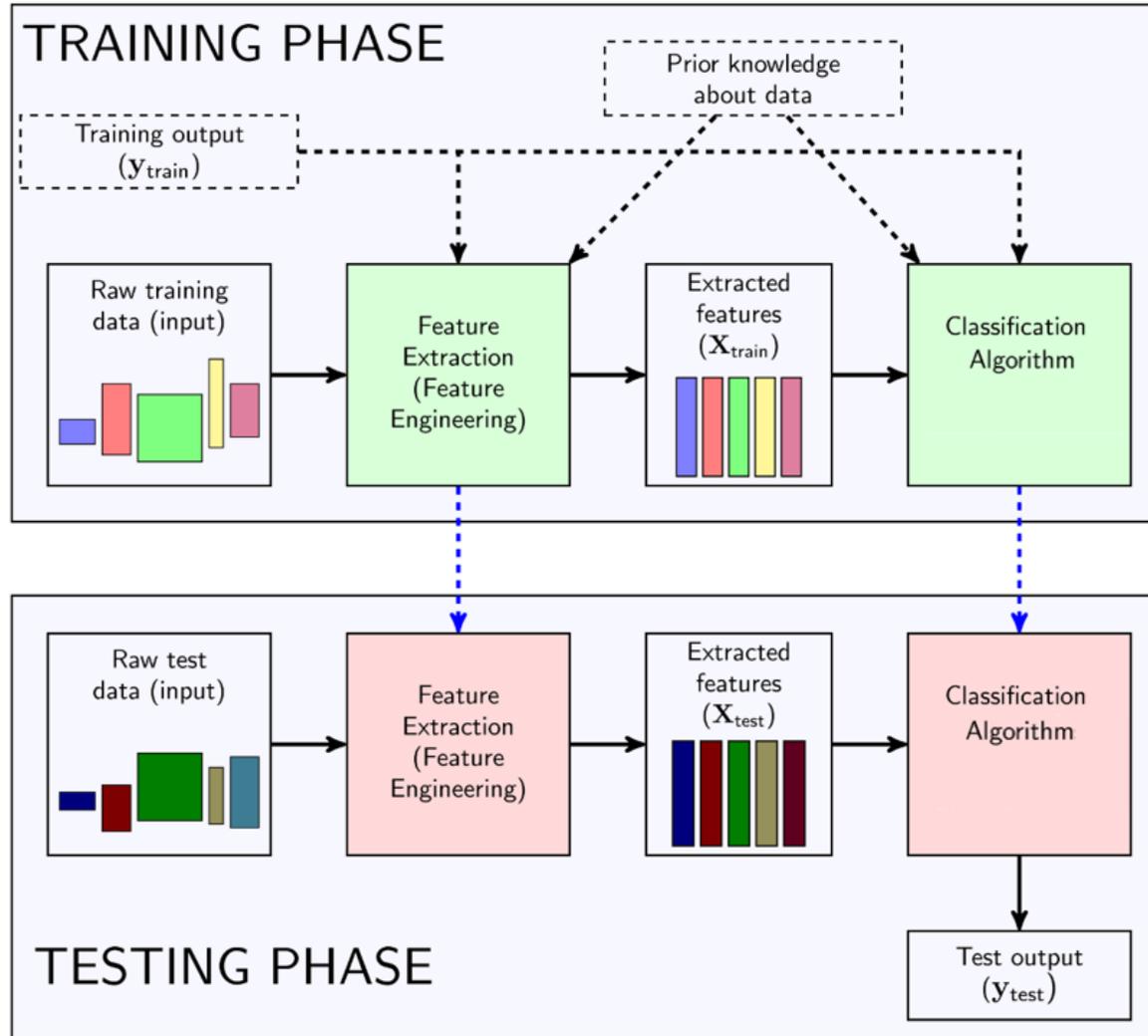
1 Introduction

2 Why non-contact sensing

3 **Our contribution**

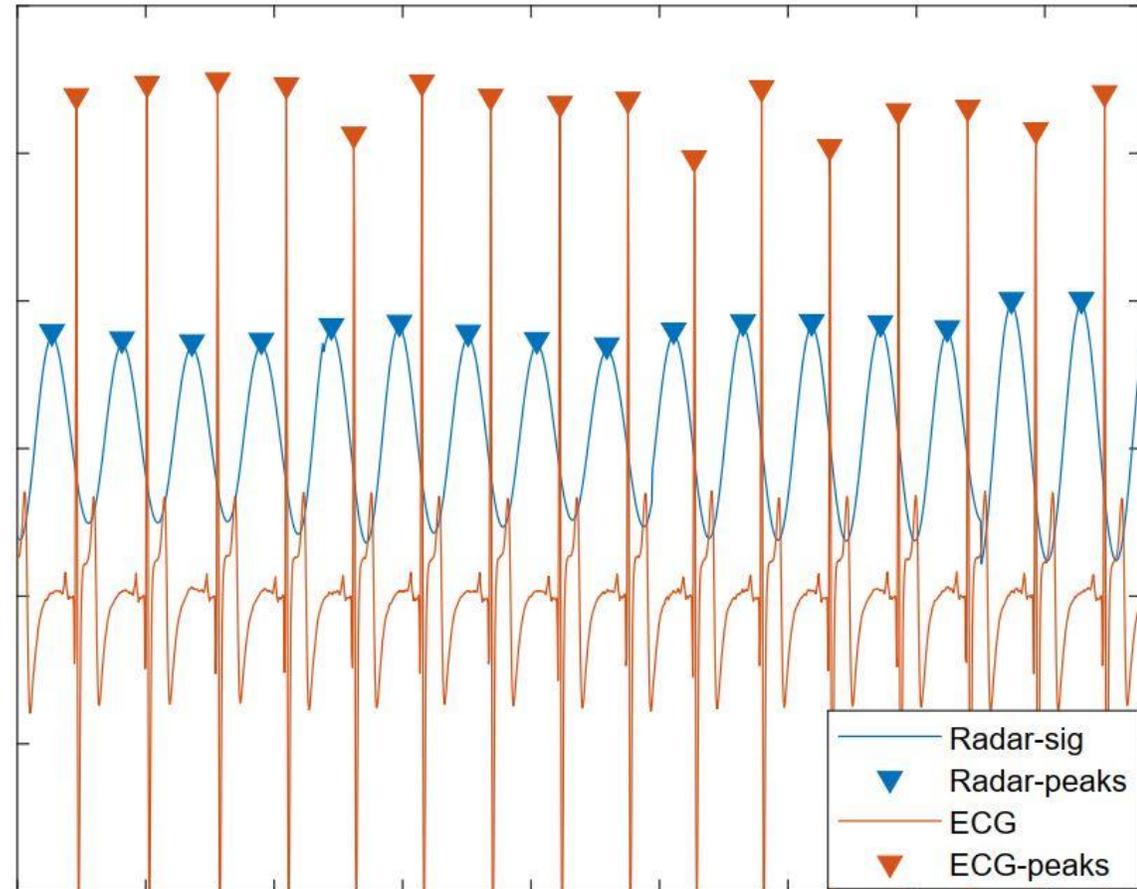
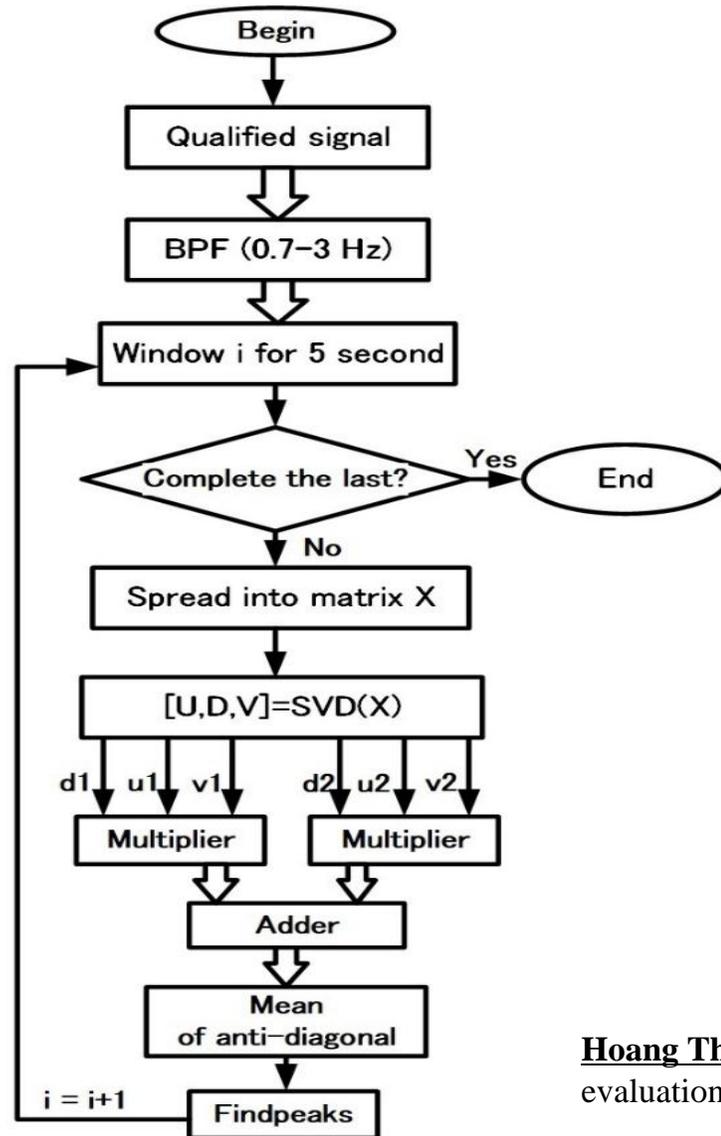
4 Future potential

Our contribution



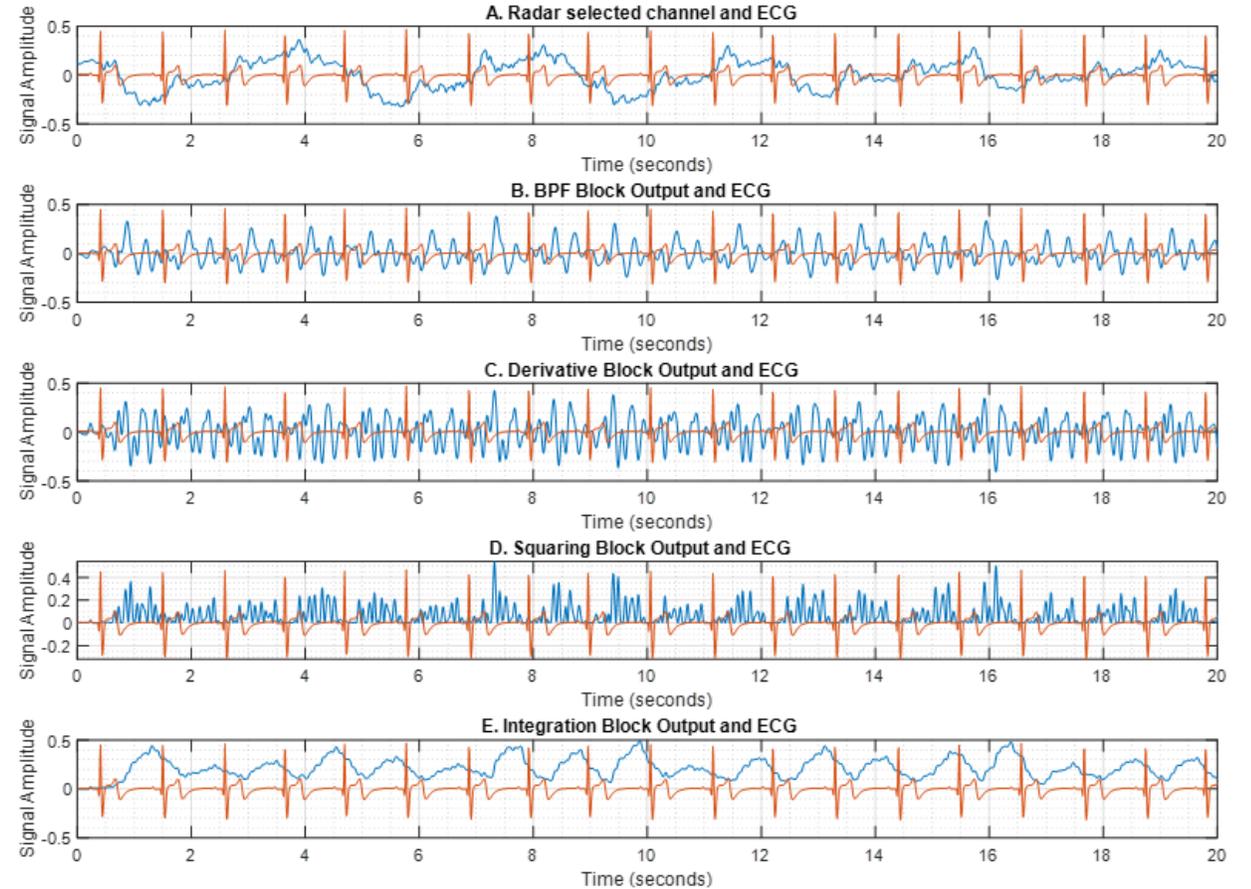
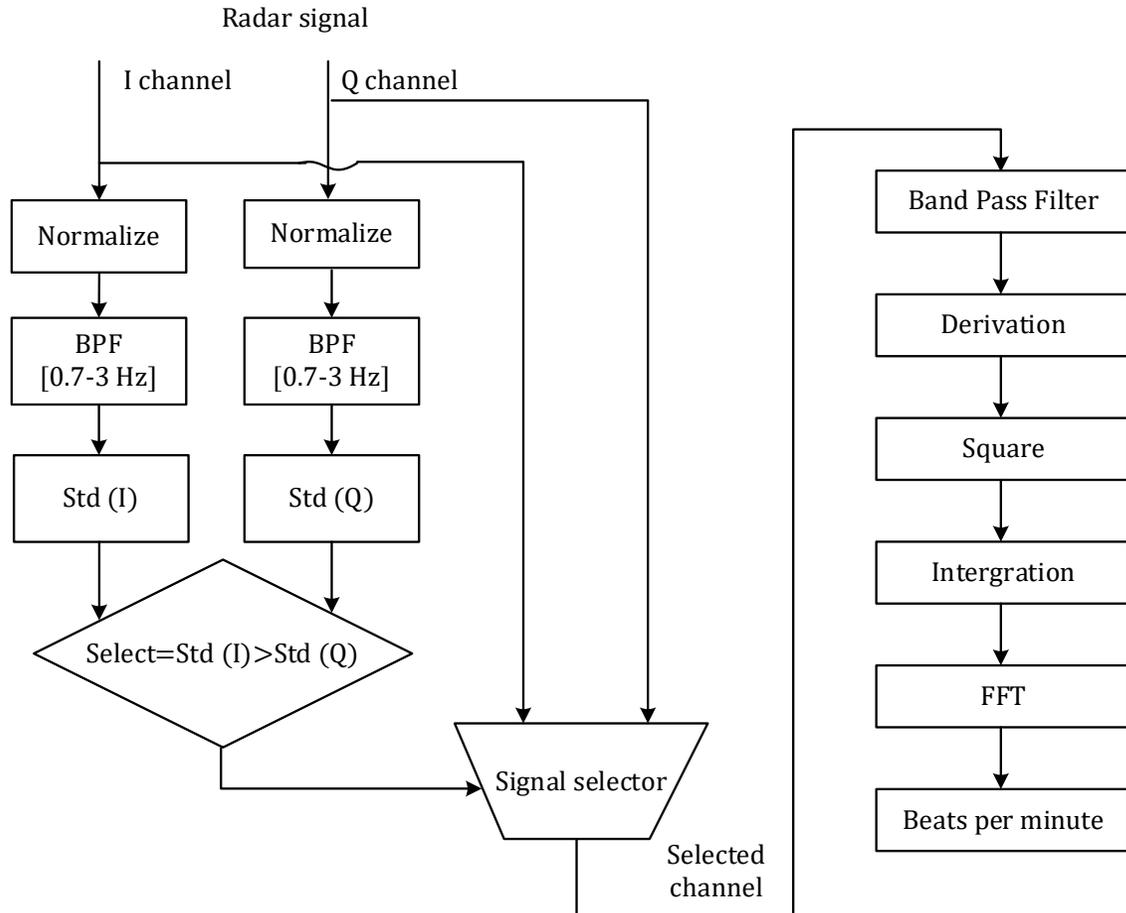
Hoang Thi Yen, et al. "A medical radar system for non-contact vital sign monitoring and clinical performance evaluation in hospitalized older patients." *Biomedical Signal Processing and Control* 75 (2022): 103597.

Heart rate (HR) detection



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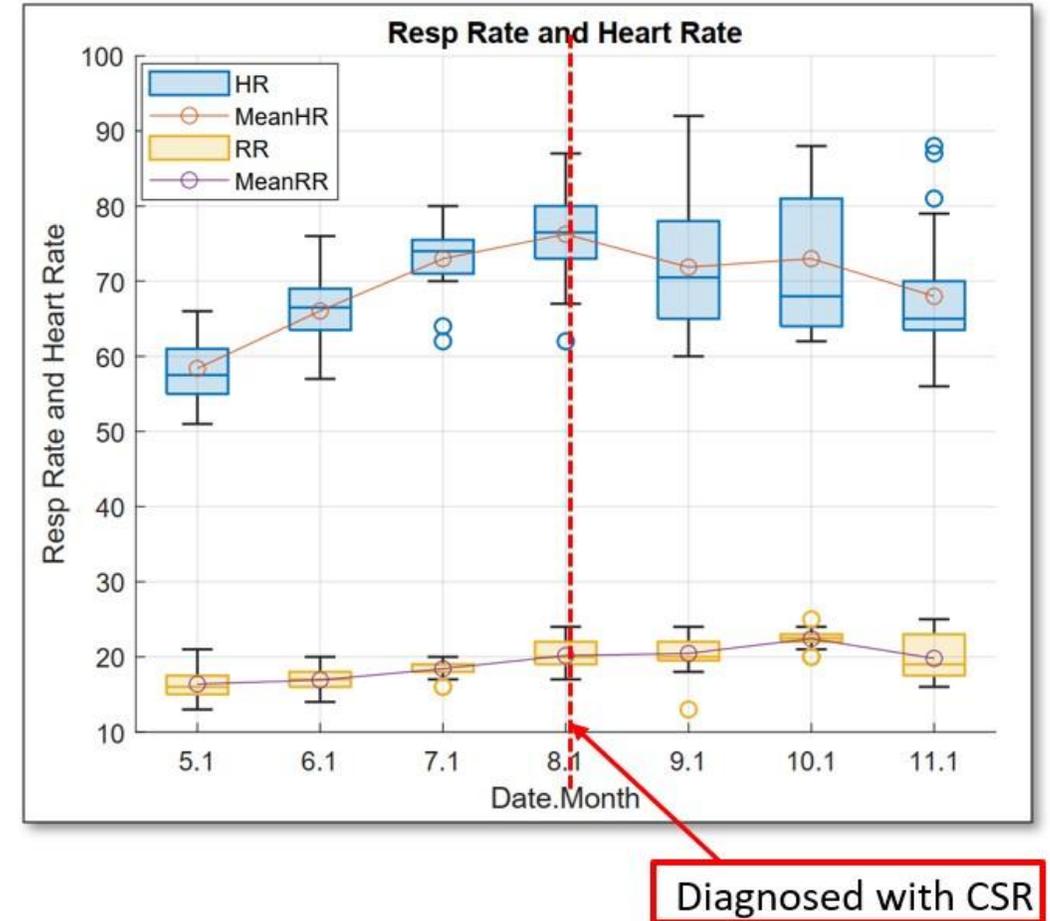
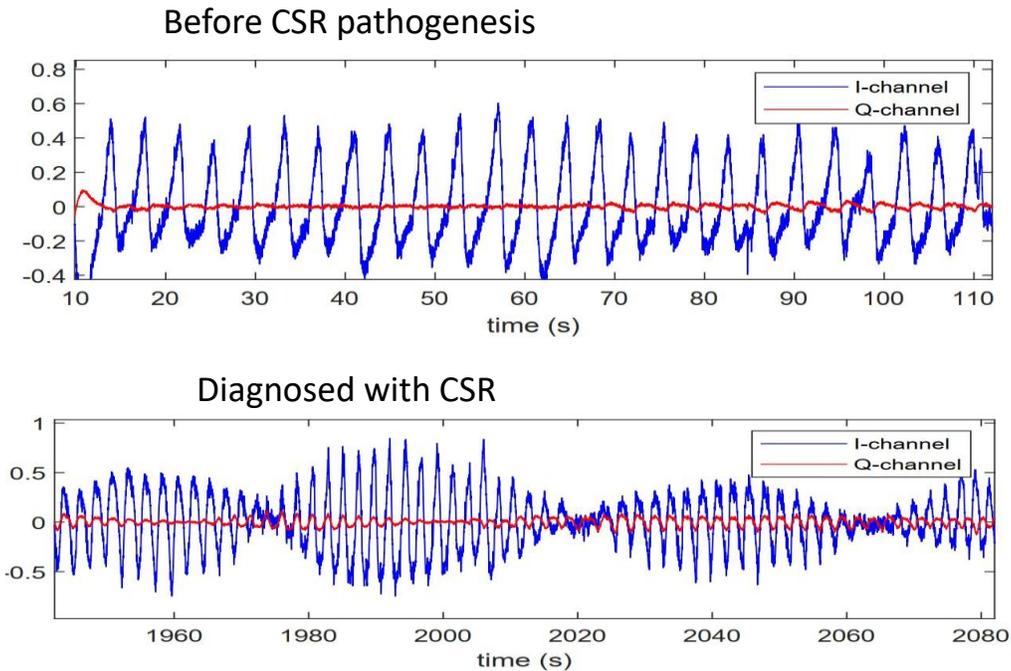
Heart rate (HR) detection



Hoang Thi Yen, et al. "Radar-based contactless heart beat detection with a modified Pan–Tompkins algorithm." *Biomedical Physics & Engineering Express* 11.1 (2024): 015007.

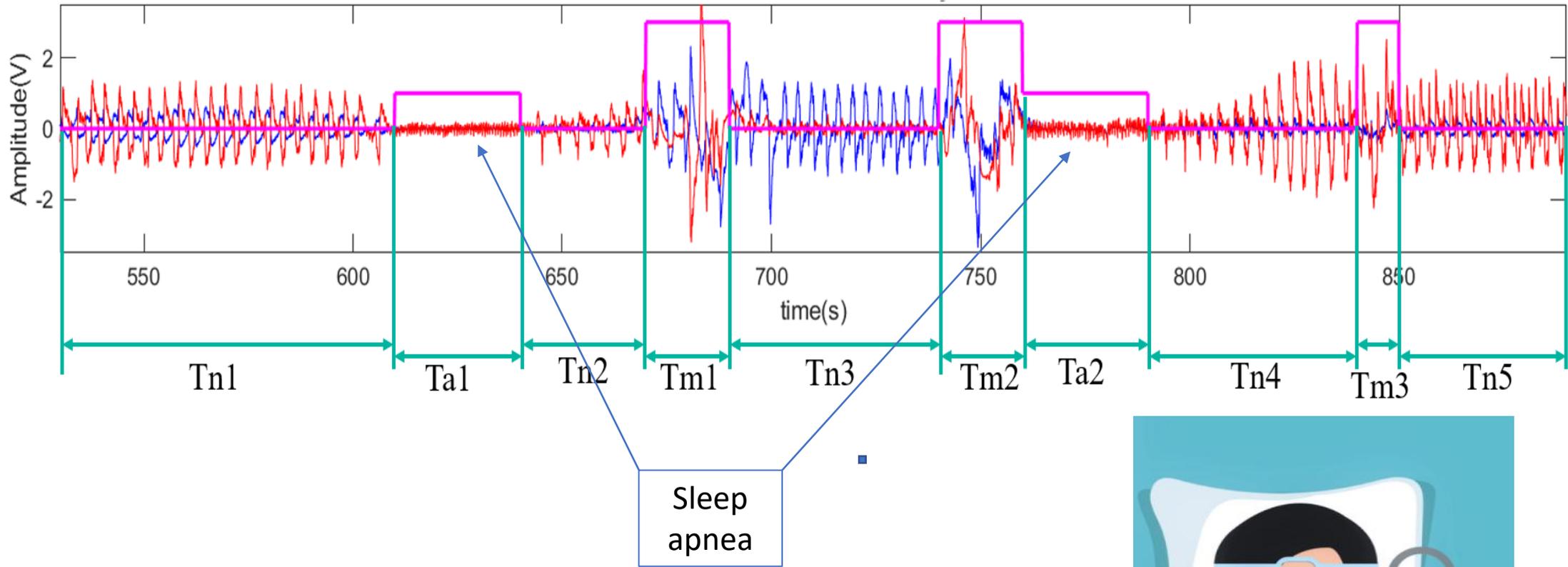
RR and HR detection on clinical data

- Detect RR and HR of clinical data
- There is abnormal
- This patient was diagnosed with Cheyne-Stokes respiration (CSR)



Hoang Thi Yen, et al. "A medical radar system for non-contact vital sign monitoring and clinical performance evaluation in hospitalized older patients." *Biomedical Signal Processing and Control* 75 (2022): 103597.

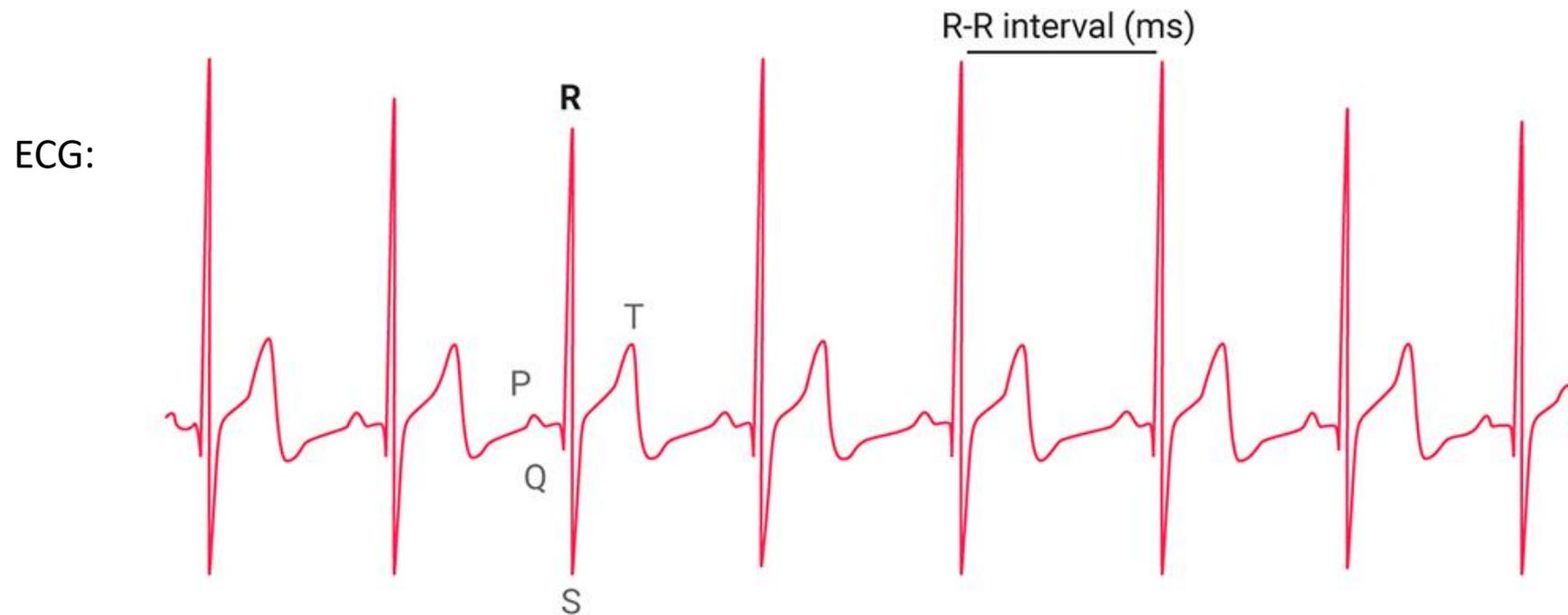
Sleep apnea detection: clinical data



Hoang Thi Yen, et al. "Sleep apnea patient monitoring using continuous-wave radar." *2023 IEEE Statistical Signal Processing Workshop (SSP)*. IEEE, 2023.

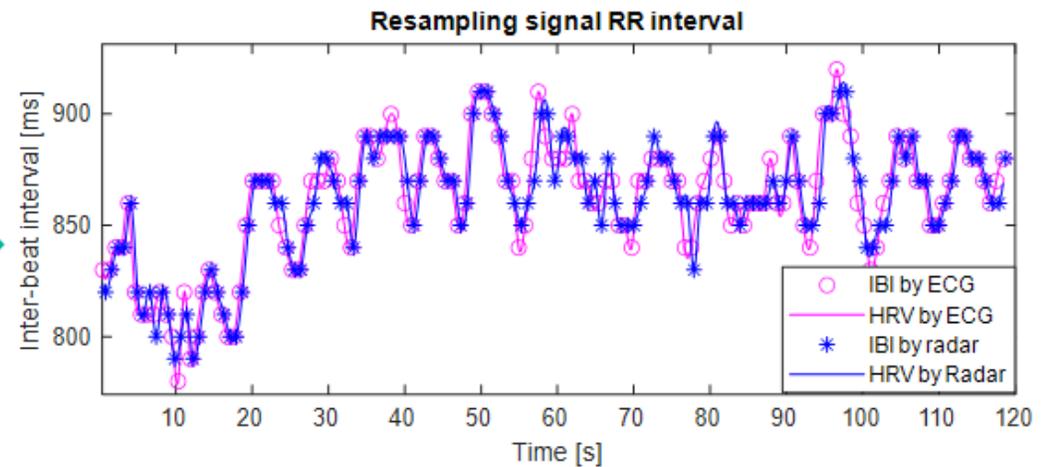
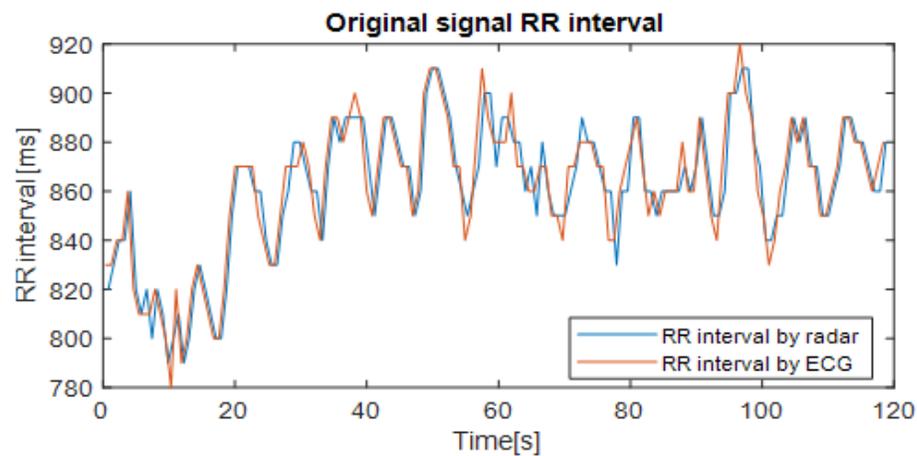
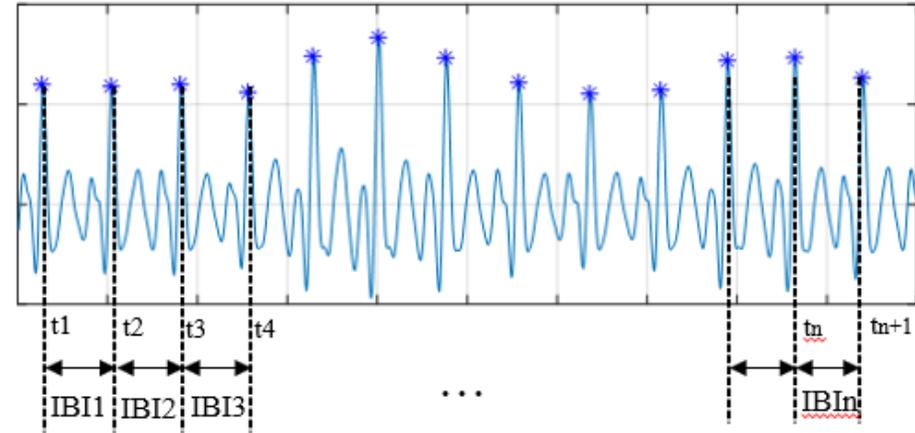
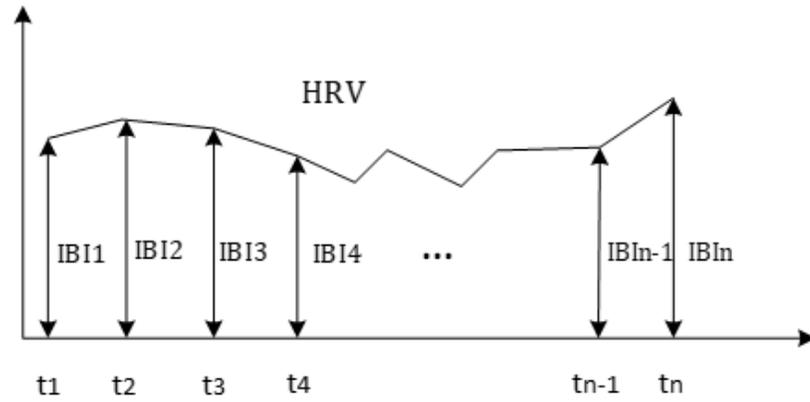
HRV detection

- ✓ Heart rate variability (HRV) is the physiological phenomenon of the variation in the interval between consecutive heartbeats.
- ✓ HRV illustrates the fluctuation in the interval between heartbeats, called the inter-beat interval (IBI) or called R-R interval in ECG, owing to the influence of the autonomic nervous system.

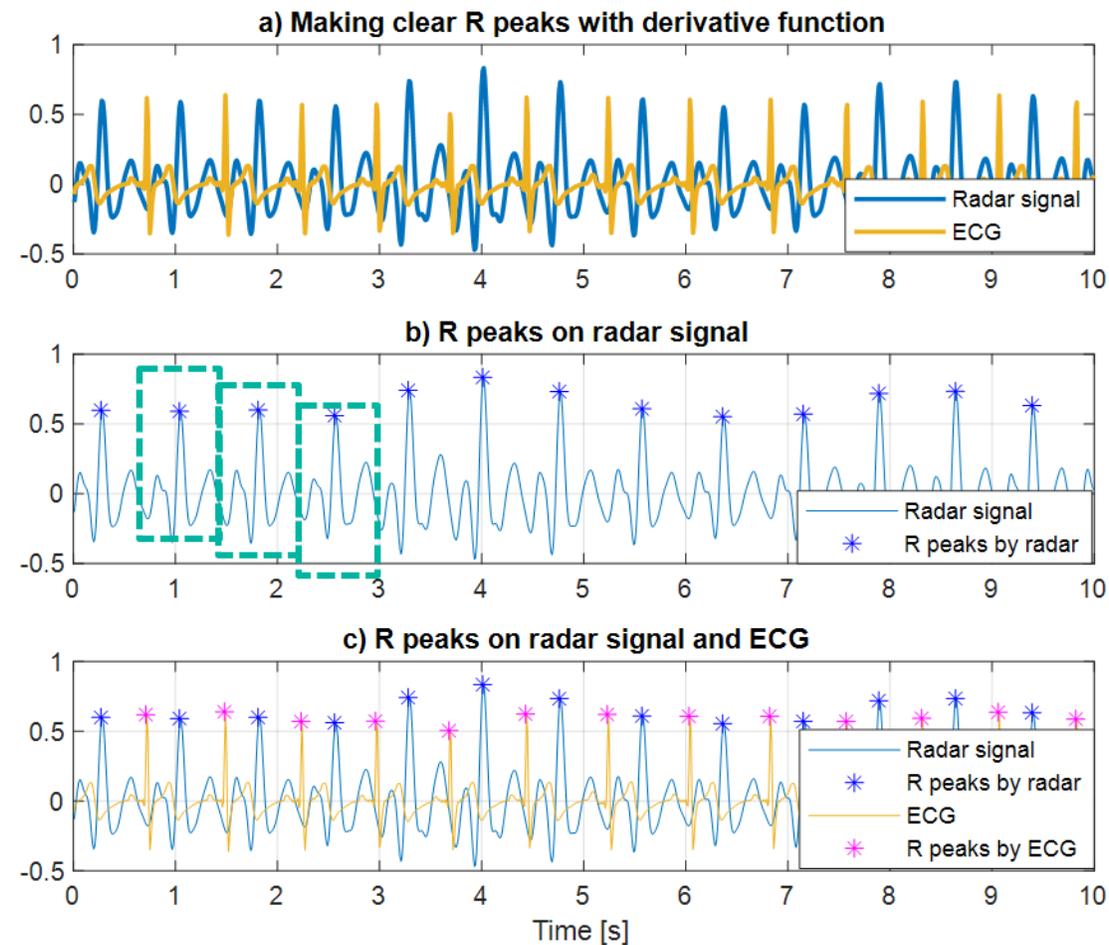
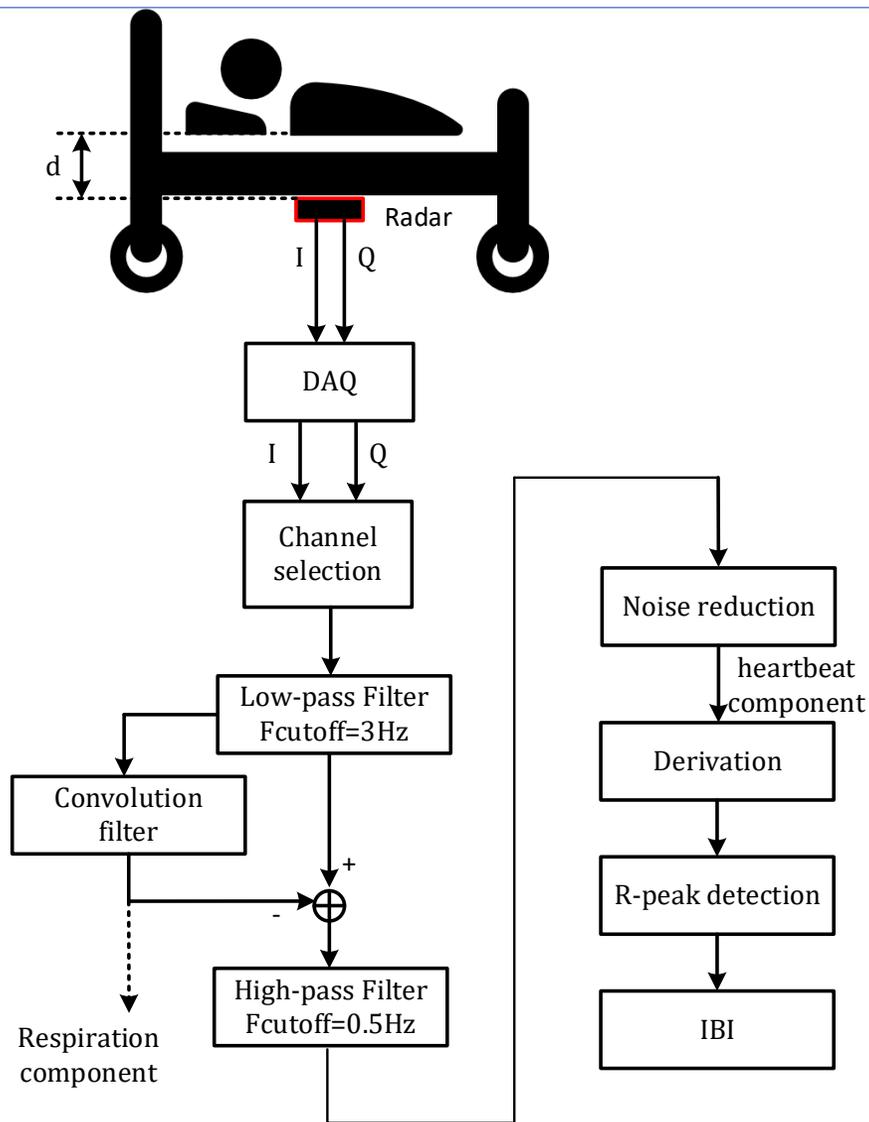


HRV calculation

Radar and ECG

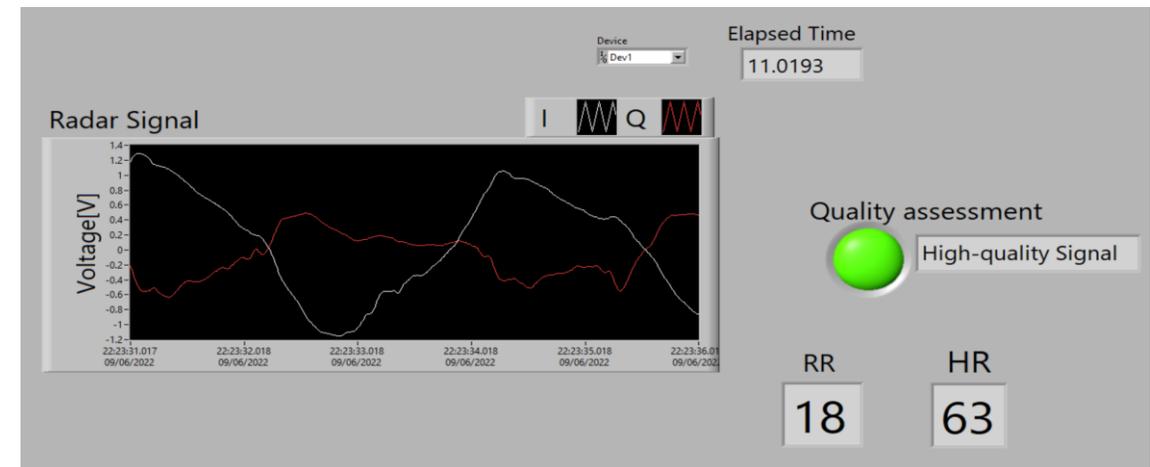
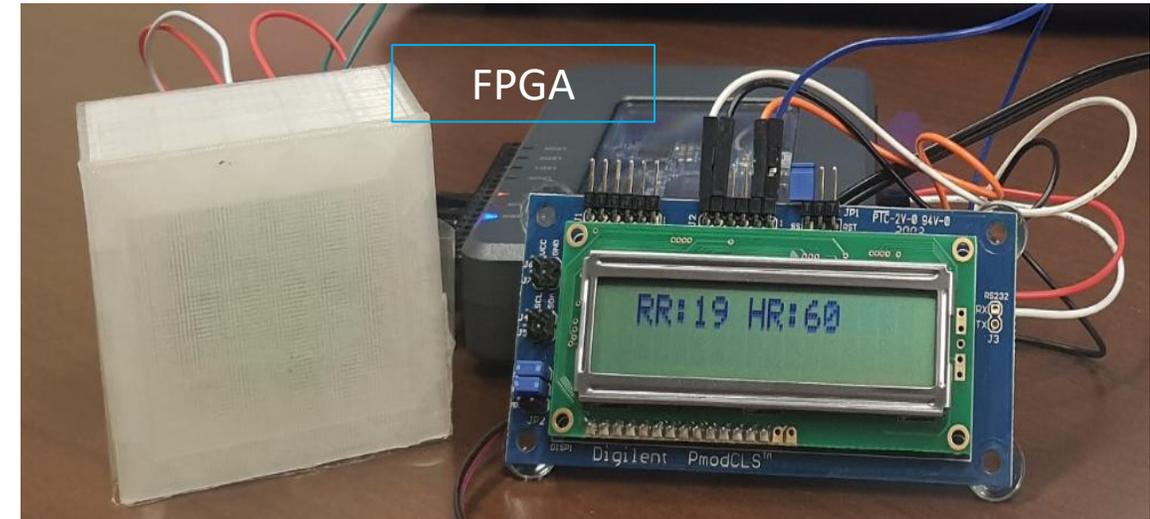
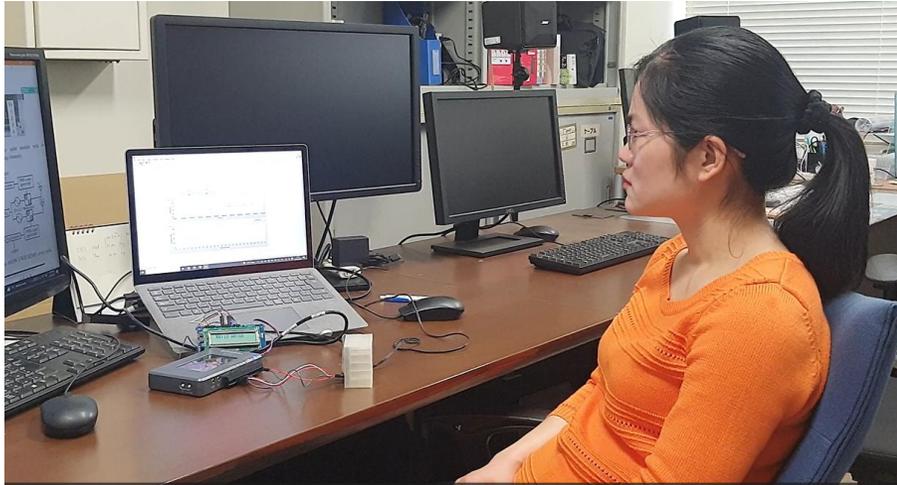


HRV detection

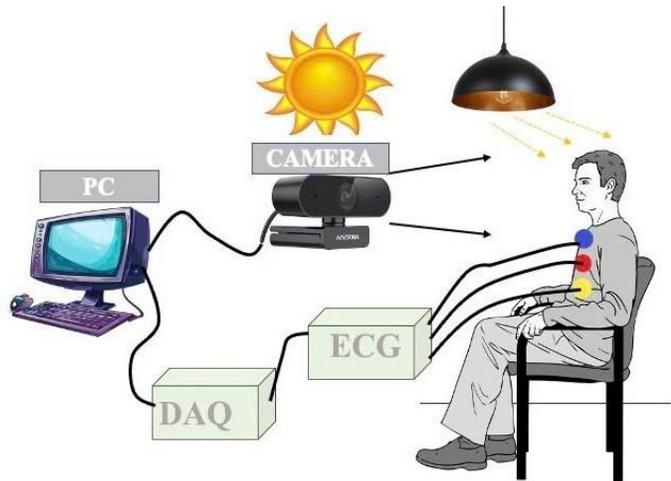
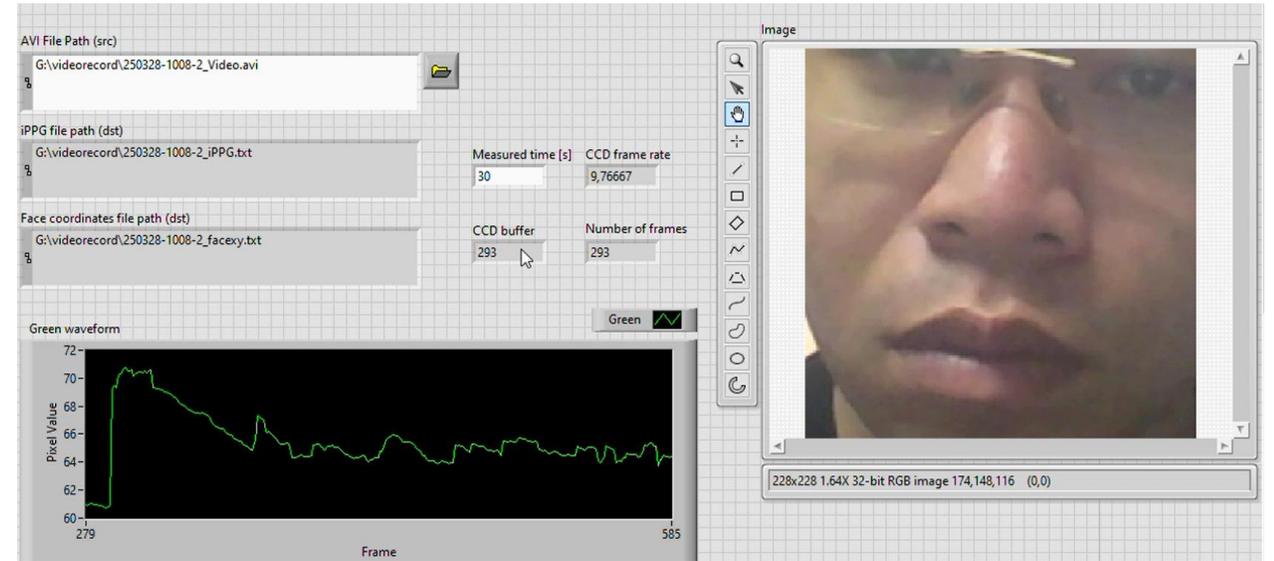
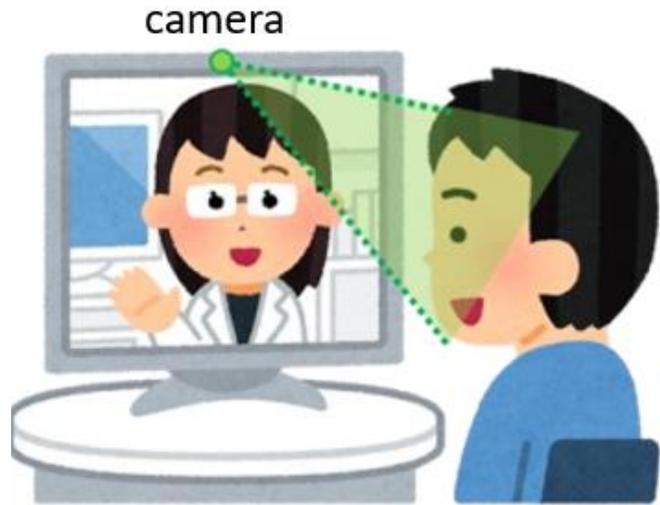


*Noise reduction by LPNR (Locally projective noise reduction)

Real-time performance



Real-time performance



1. Nguyễn Duy Hiếu, Hoàng Thị Yên et al. “Tính toán nhịp tim bằng phương pháp không tiếp xúc sử dụng RGB camera”. REV-ECIT 2024
2. Hoang Thi Yen et al. “RGB camera-based pulse rate estimation using continuous wavelet transform and convolutional neural network”, 2025 journal (under review)

1

Introduction

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Why non-contact sensing

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Our contribution

4

Future potential

Future potential

Monitoring
in nursing facilities etc.

Monitoring with TV
during dairy life



Monitoring with PC
at work



Healthcare mirror



Home use portable



Thank you for listening!



No electrode

