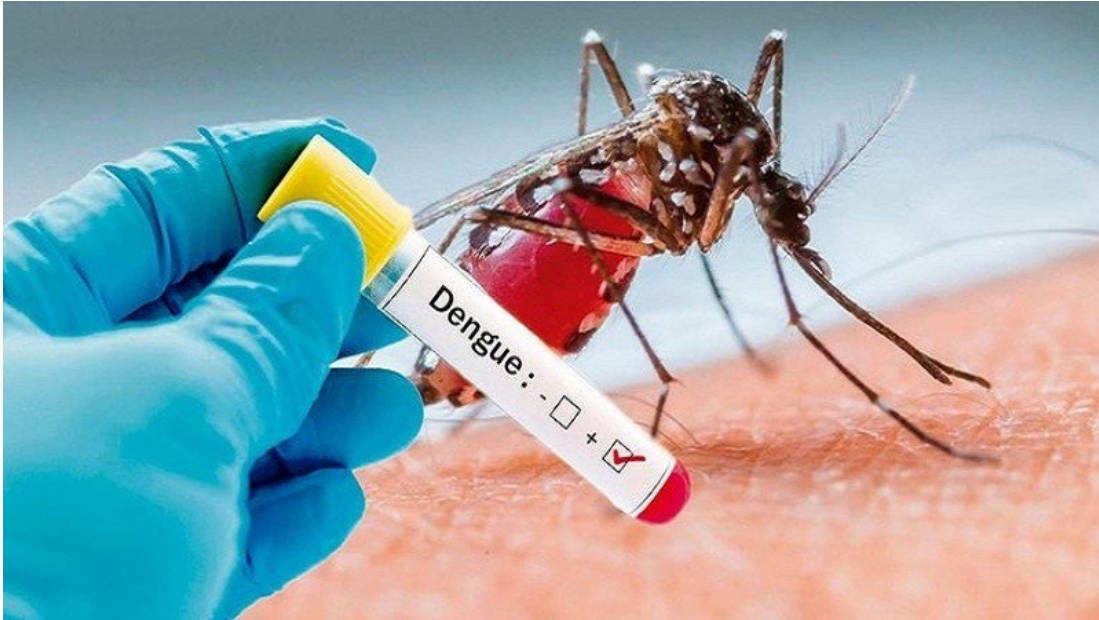


An Internet-of-medical-things system for contactless monitoring of Dengue fever using signal processing and machine learning

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<https://pacificcross.com.vn/dengue-fever/>

ASEAN countries: tropical climate, serious infectious disease – specially **Dengue fever**



Dengue fever in ASIAN 2024 *

Country	Dengue case	Death	Compared to 2023
Cambodia	12 689	36	↘
Lao	13 802	—	↘ with 40.9%
Malaysia	98 422	89	↘ with 19.34%
Singapore	11 683	—	↘ with 81.75%
VietNam	71 300	11	↘ with 40.9%



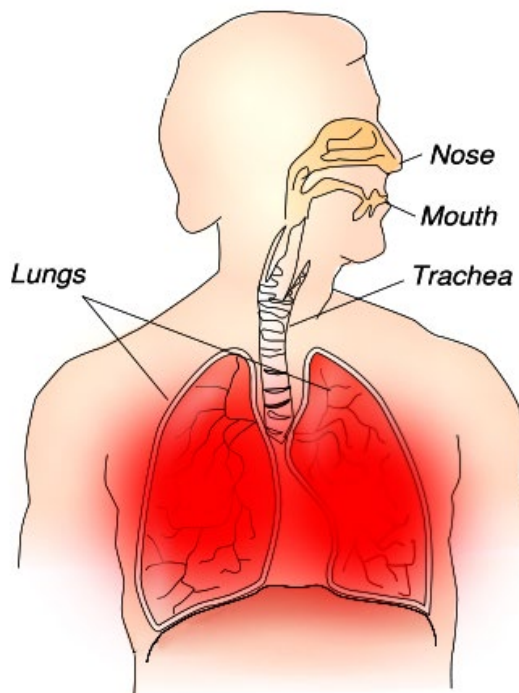
Climate change cause a spread outside of ASEAN region, e.g. Japan



This project aims to develop an Internet-of-Medical-Things (IoMT) system for contactless monitoring of Dengue fever via vital sign data derivation and analysis based on signal processing and machine learning techniques.

WHO: Dengue and severe dengue (2024)

*: Reported up to week 36 of 2024 since 1 January 2024, compared to same period 2023 with Dengue cases (WHO - Update on the Dengue situation in the Western Pacific Region)



Associated with inflammation

Included in the diagnostic criteria for the **Systemic inflammatory response syndrome (SIRS)**

Infection type	Temp (°C)	HR (bpm)	RR (bpm)
Typhus	40~41	110~120	30~40
Influenza	40~41	110~120	30~35
Bloody flux	38~39	120~130	—
Malaria	40~41	> 100	—
Measles	40~41	120~140	35~40
Tetanus	39~40	100~110	25~30
Dengue	38~40*	90~115	25~35

As a result of being infectedd,
body temperature, heart rate and **respiration rate** increase

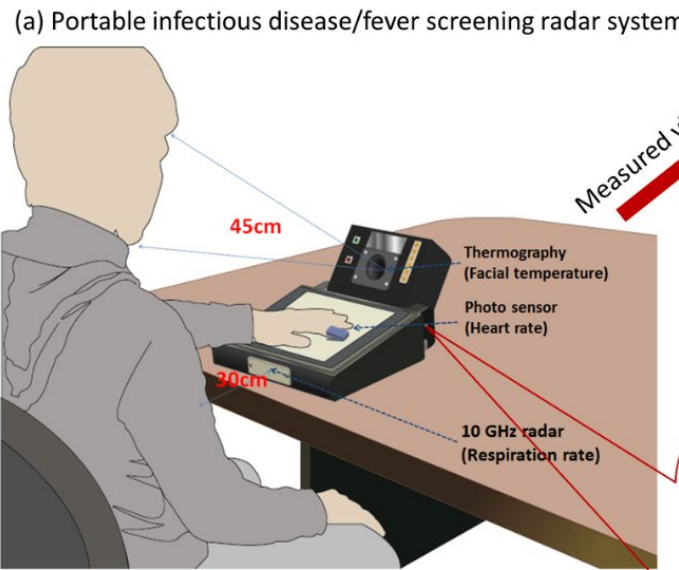
*: Febrile phase lasting 2-7 days in Dengue patients

Non-contact vital-sign measurements

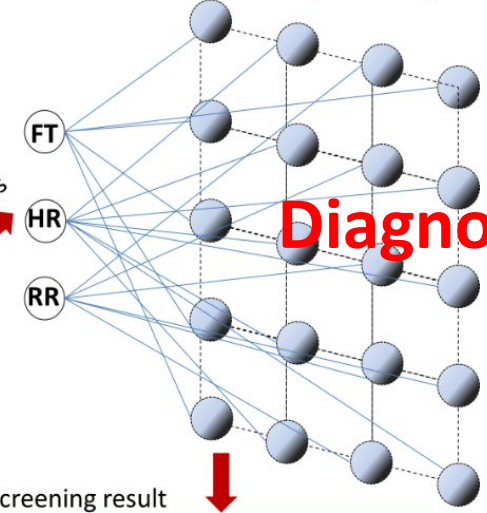
Doppler radar:
Body movements

Thermal scanner:
Heat images of body

Oximeter:
photoplethysmograms (PPG)



(b) Neural network and the fuzzy clustering method



Diagnosis

Analysis of Dengue fever with different stages

(c) Screening result



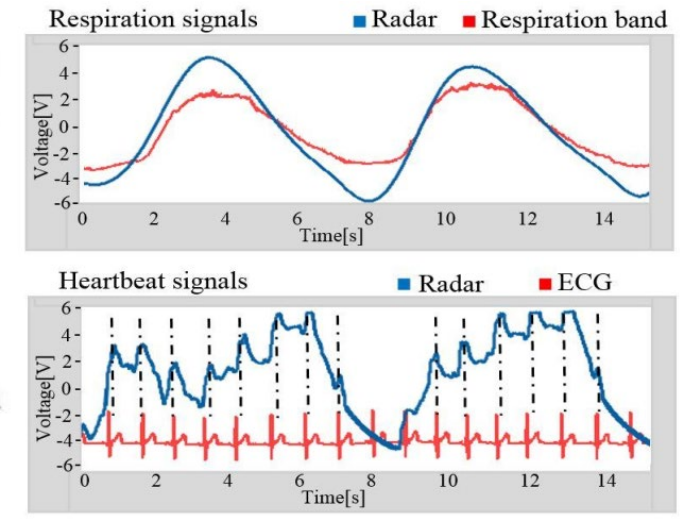
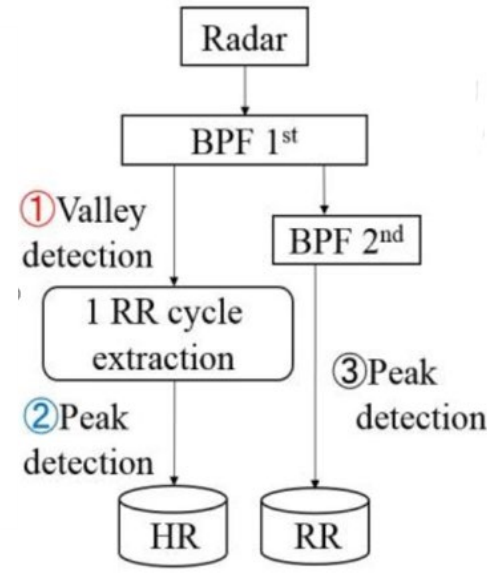
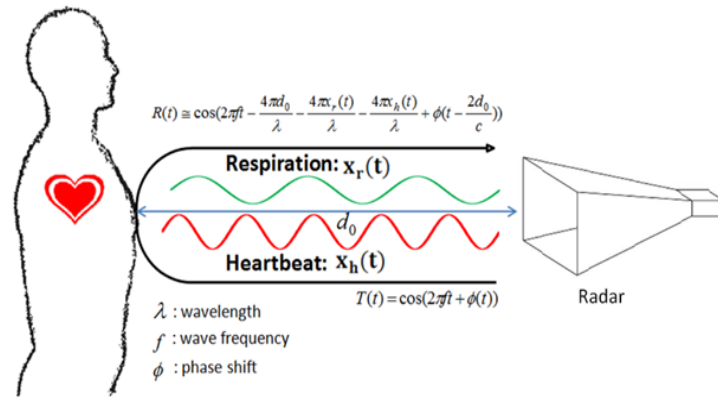
Screening within **10 s**

Sun G et al: An infectious disease/fever screening radar system which stratifies higher-risk patients within ten seconds using a neural network and the fuzzy grouping method. *Journal of Infection*, (2015)

HT Yen et al: A medical radar system for non-contact vital sign monitoring and clinical performance evaluation in hospitalized older patients, (2022)

Sun G et al: Performance Enhancement of Thermal Image Analysis for Non-contact Cardiopulmonary Signal Extraction, (2024)

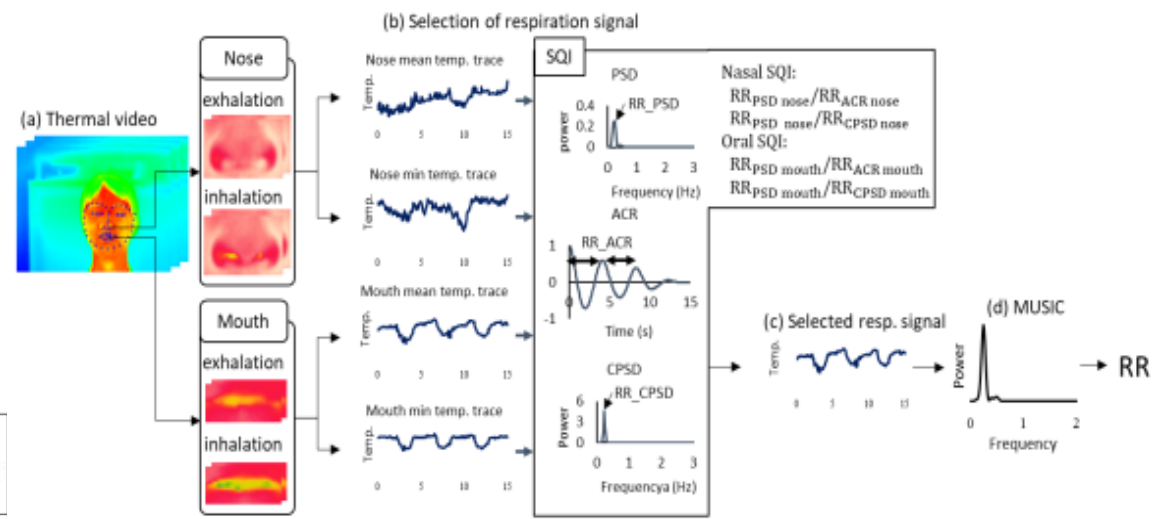
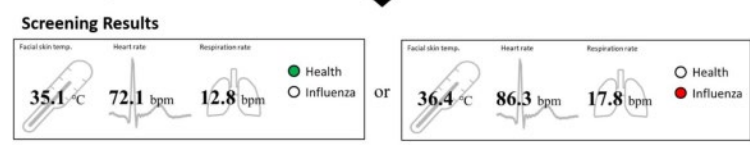
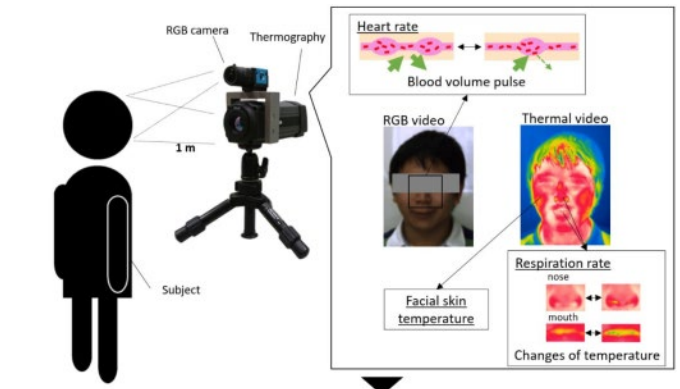
Radar signal processing



Thermal image processing

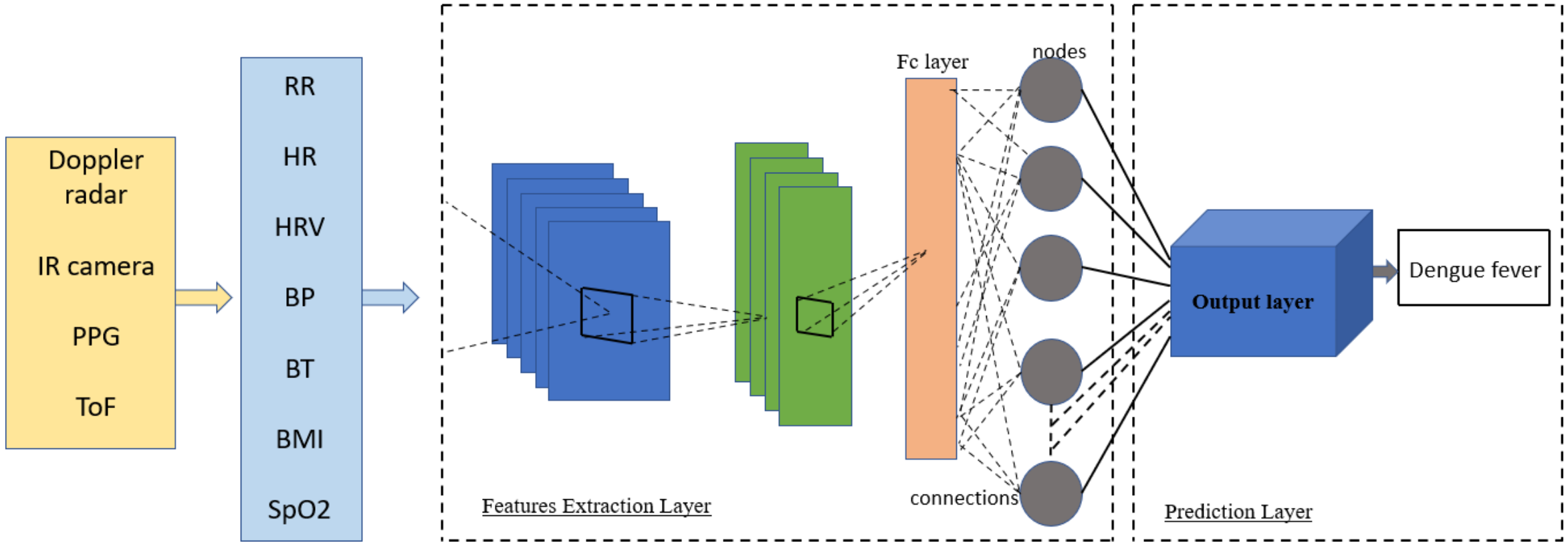


FLIR A315



Sun G. et al "Contactless Vital Signs Measurement System Using RGB-Thermal Image Sensors and Its Clinical Screening Test on Patients with Seasonal Influenza". (2020)

Yang. X. et al "Non-contact Acquisition of Respiration and Heart Rates Using Doppler Radar with Time Domain Peak-detection Algorithm". (2017)



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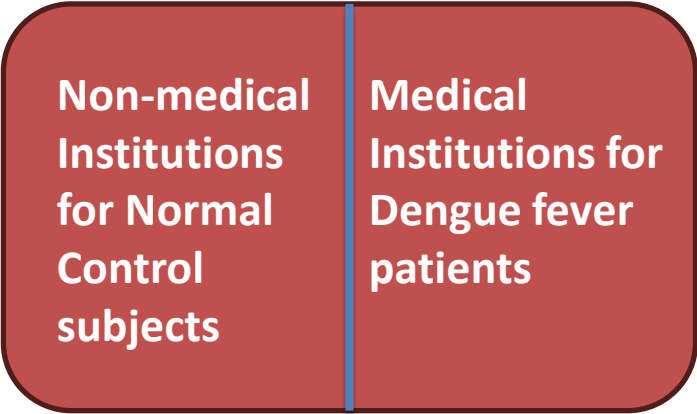


Le Qui Don Technical University



VNU University of Engineering and Technology

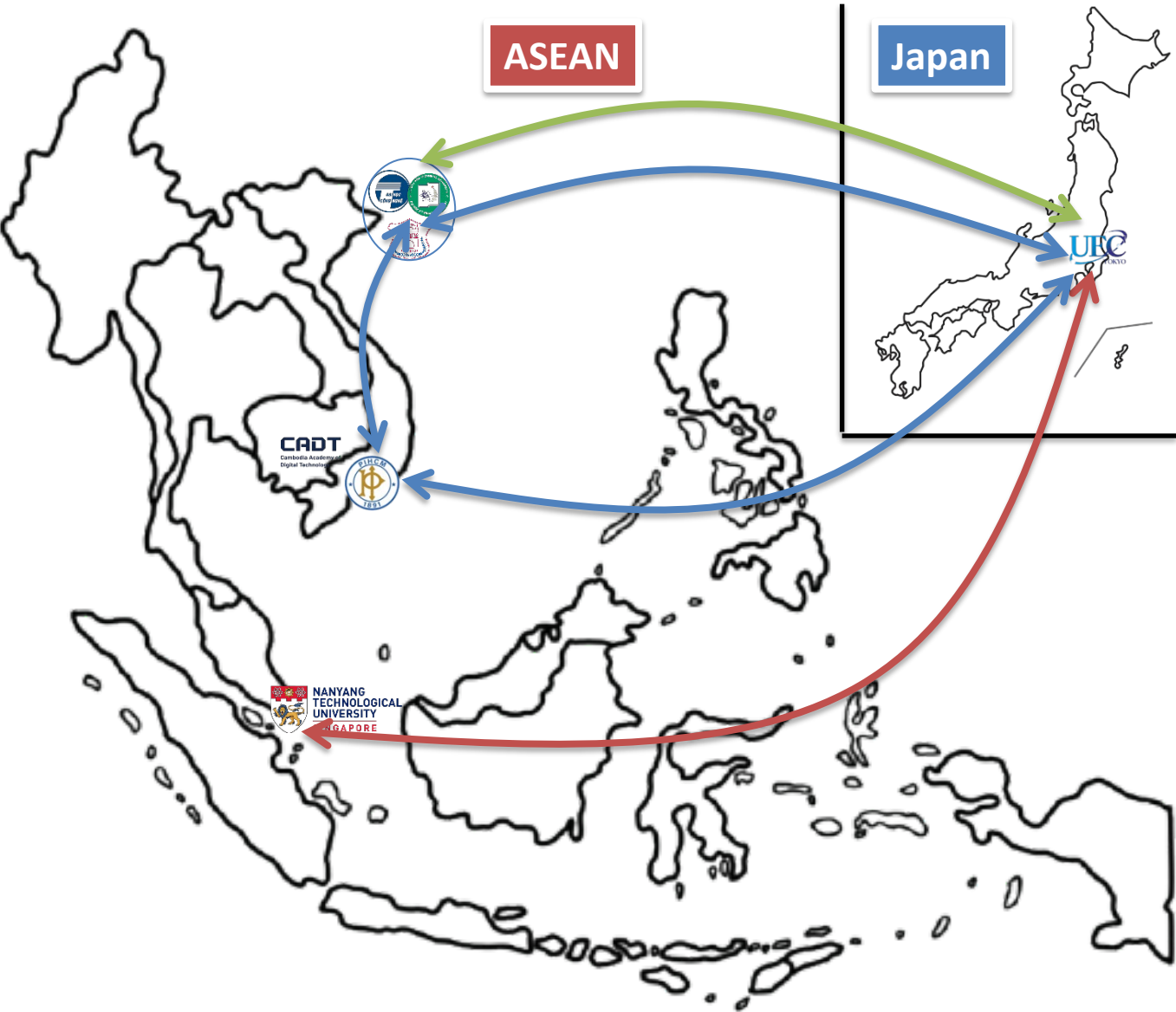
Acquiring data & Trial in **Vietnam**



Pasteur institution
Ho Chi Minh



Ha Noi Medical University Hospital



Technology transfer and expert consultancy



Thermal imaging expertise






Advanced signal processing and machine learning capabilities

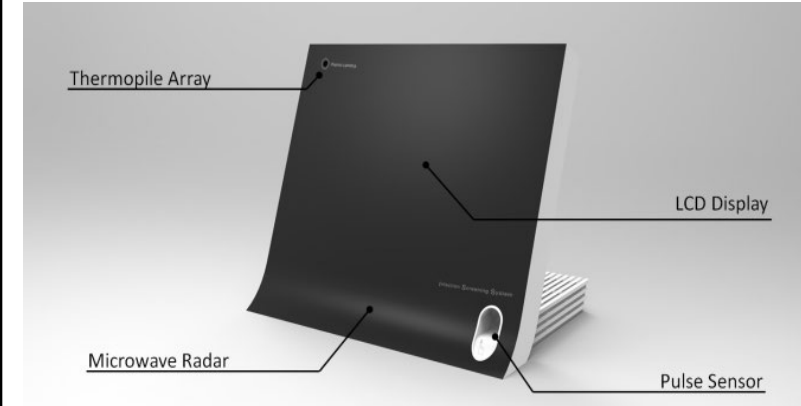


Clinical partnerships in infectious disease research



Pioneering digital health collaborations

-  HMU, PIHCM with UEC, VNU-UET, and LQDTU with Multidisciplinary collaboration between medical and engineering institutions
-  UEC, VNU-UET, & LQDTU joint supervision of students and interdisciplinary research
-  UEC & NTU with Collaboration in thermal imaging research and application

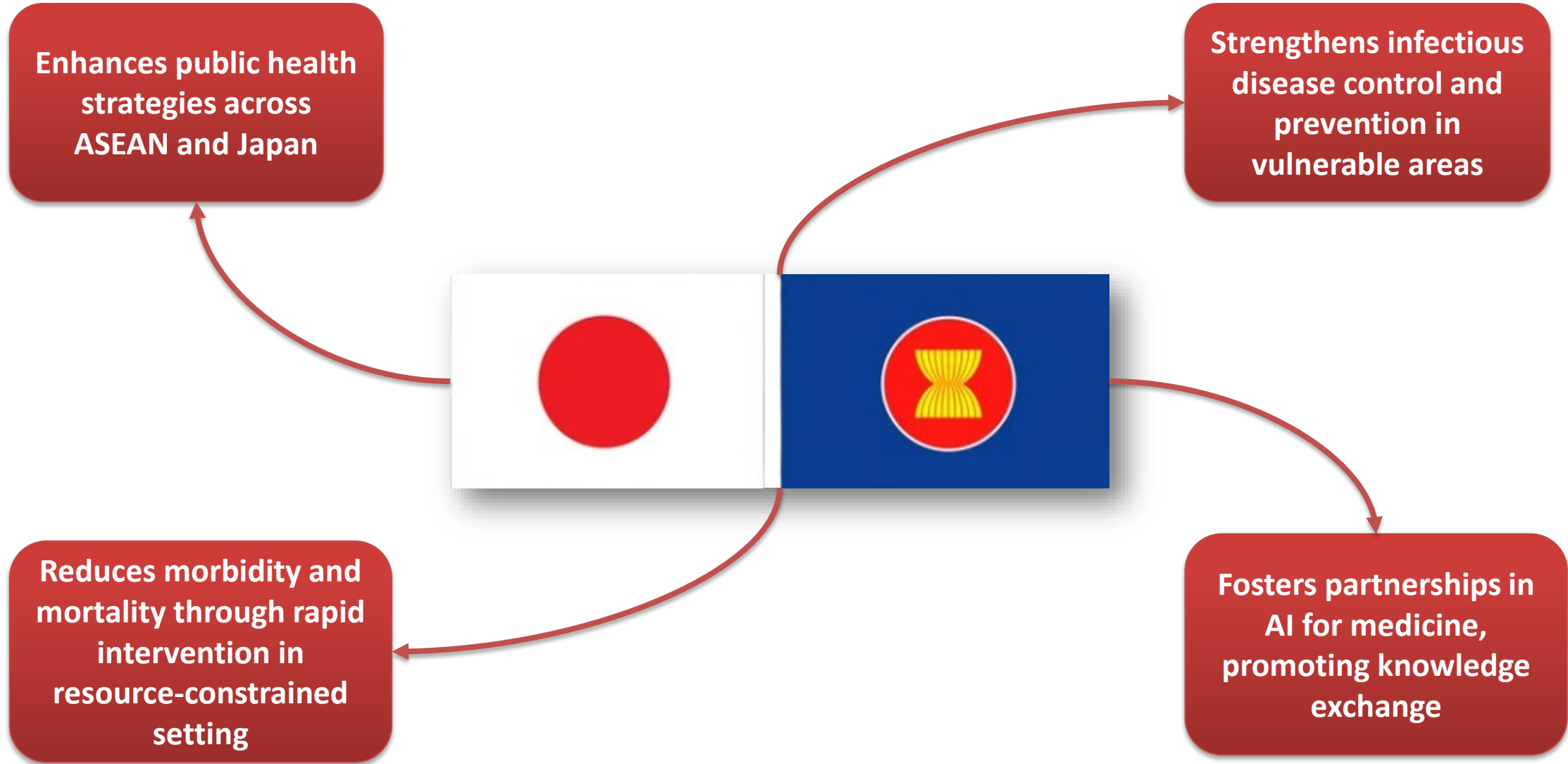


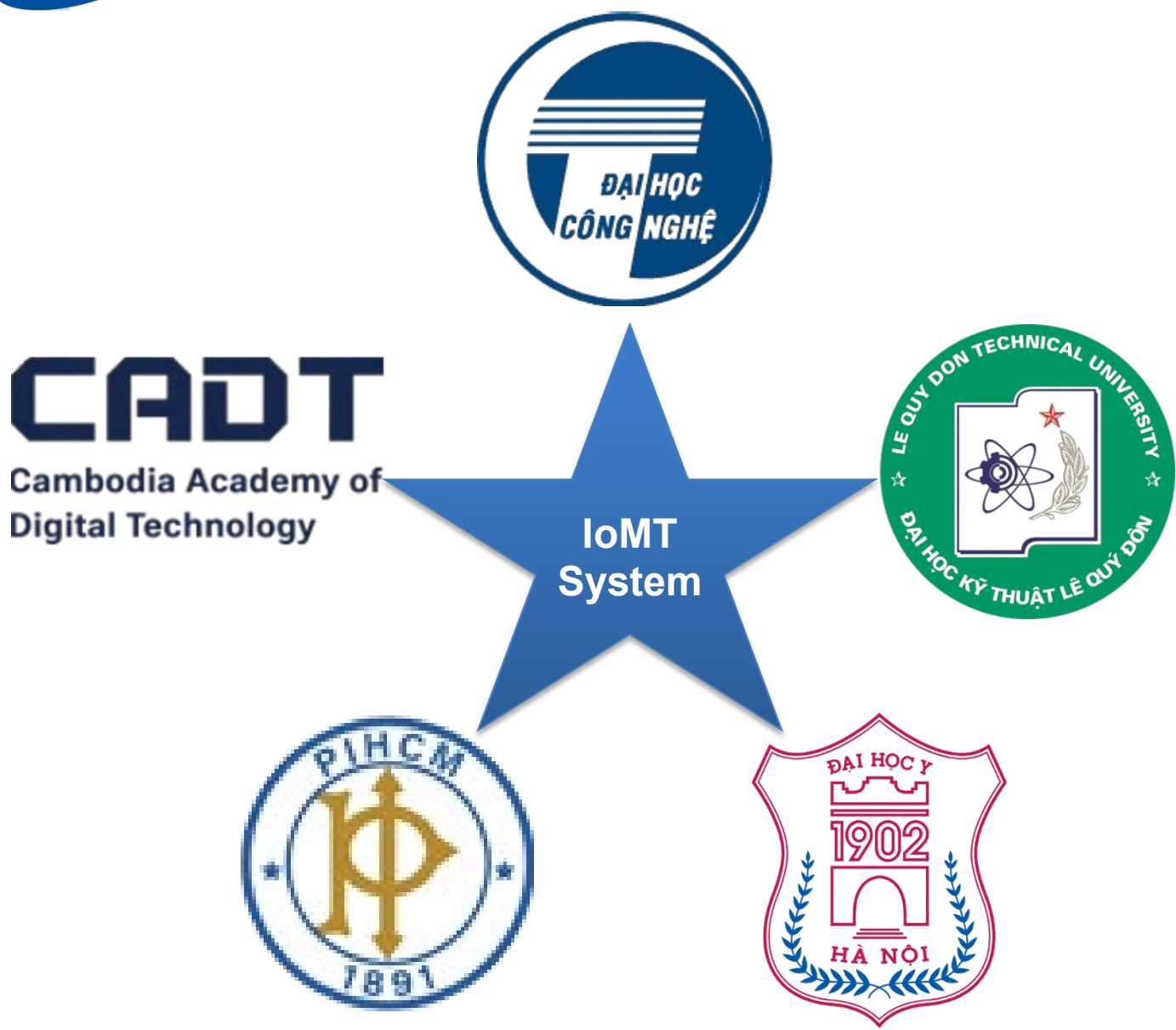
Redesign the system to make it low-cost, portable sized, and user-friendly design. (Co-working with SAMSUNG's Product Designer)

Expanding IoMT to monitor various infectious diseases requiring vital sign tracking

Establishes groundwork for real-time remote health monitoring beyond Dengue fever







Develop a network of 5 terminals at VNU-UET, LQDTU, HMU, PIHCM, and CADT



Each terminal equipped with Doppler radar, infrared thermal scanner, and optional pulse oximeter.



High precision extraction of RR, HR, HRV, BT, and BP using advanced signal processing and machine learning.



Data acquisition from 300 Dengue patients and 200 normal controls for efficient screening



Employ machine learning techniques to analyze different stages of Dengue fever

No.	Outcome	Details
1	IoMT system	Connecting: VNU-UET, LQDTU, PIHCM, HMU, CADT
2	Joint publications	3 journal articles, 3 conference papers
3	2 workshops	Hanoi, Vietnam Phnom Penh, Cambodia
4	Training output	2 bachelor students, 2 master students, 1 PhD student

- This study aims to design **a potential IoMT** system for screening infectious diseases through vital sign monitoring.
- The IoMT contactless monitoring system enables status analysis of **different stages of Dengue fever**
- **Foster collaboration** in the field of AI for medicine and health for infectious disease between Japan and ASEAN countries.