SNS COLLEGE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

Approved by AICTE & Affiliated to Anna University
Accredited by NBA & Accrediated by NAAC with 'A++' Grade,
Recognized by UGC Saravanampatti (post), Coimbatore-641035.

Department of Biomedical Engineering

Course Name: 19BMO302 & WEARABLE TECHNOLOGIES

Topic : Cardiac Activity

Semester :6

NEED FOR WEARABLE TECHNOLOGY

Existing approaches with a Smartphone:

Adding specialized sensors
-- *Not accessible to a wide range of users*

Using built-in sensors:

Ordinary camera as a PPG sensor

IMU with phone on the chest or the navel

-- *Require active user participation*

Sensing
+
Processing power

Always with us

HEART RATE MONITORING

Heart Rate Monitoring without active user participation

HandRate revisits Ballistocardiography (BCG)

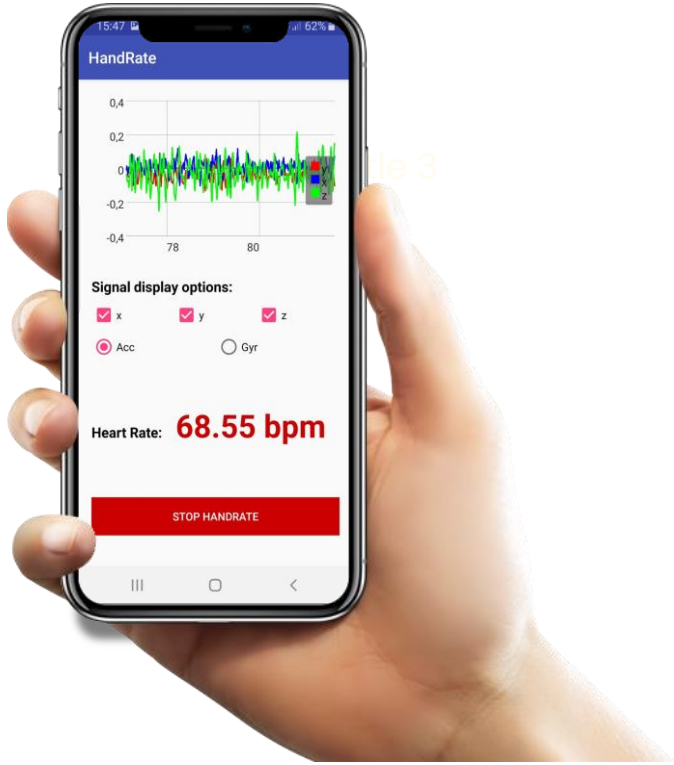
- *Measurement of the body movement during cardic cycle*
- *Caused by recoil forces (espcially during the systole)*

Two important questions :

Is it possible to acquire BCG in hand with a commodity mobile phone ?

Far away from the heart and subject to motion artifacts

If yes, which system to extract Heart Rate from it ?



Hand-BCG: is it possible?

The theoretical answer

- Smartphones' accelerometers are able to sense very weak motions
  - Typical sensitivity value: 2 x 10^{-3} $m.s^{-2}$

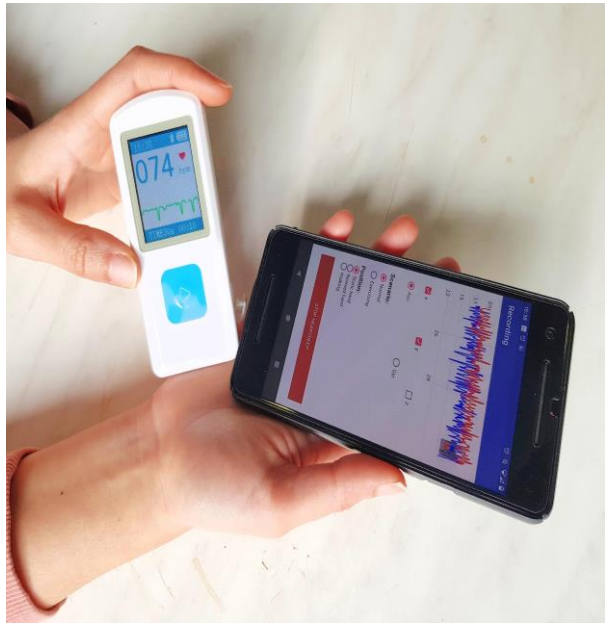
- Peaks' average in our dataset: **9 x 10^{-2} $m.s^{-2}$**
  - *barely an order of magnitude greater than the accelerometers' noise level (~2 x 10^{-2} $m.s^{-2}$*

DOMAIN ANALYSIS

Experimental study

- Collection of multiple signals: 30s per session
- Hand vs Navel (reference)

- **Frequency** Computation of signal quality : Q_{kurt} [1]



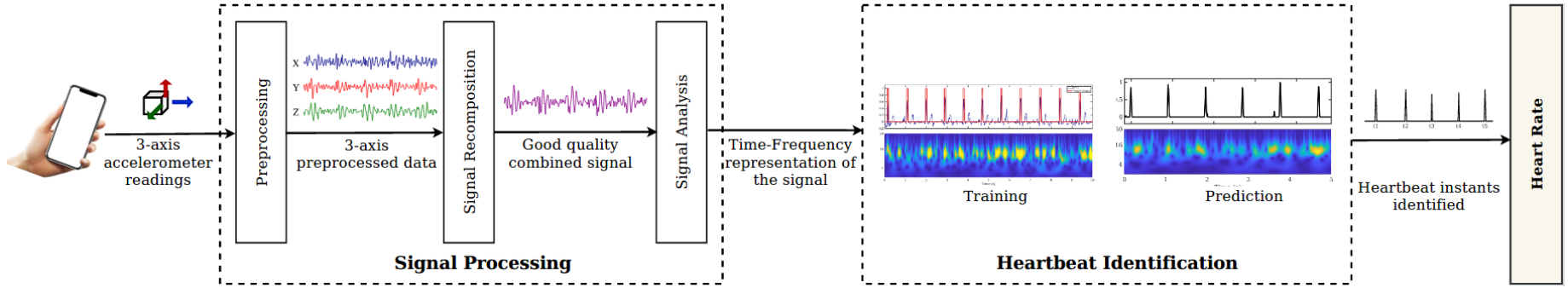
BCG signal can be sensed from hand using a smartphone' accelerometer

But this signal can be of poor quality, making Heart Rate computation challenging

BLOCK DIAGRAM OF PROCESSING

Heart Rate Monitoring system with phone in hand

Just takes as input the accelerometer readings to compute the Heart Rate



PREPROCESSING

Filtering out too weak or too strong signals

--> in the range [-1, 1]

--> Fs = 100Hz

Reduce noise

ANALYSIS

Heart rate monitoring system with a phone in hand

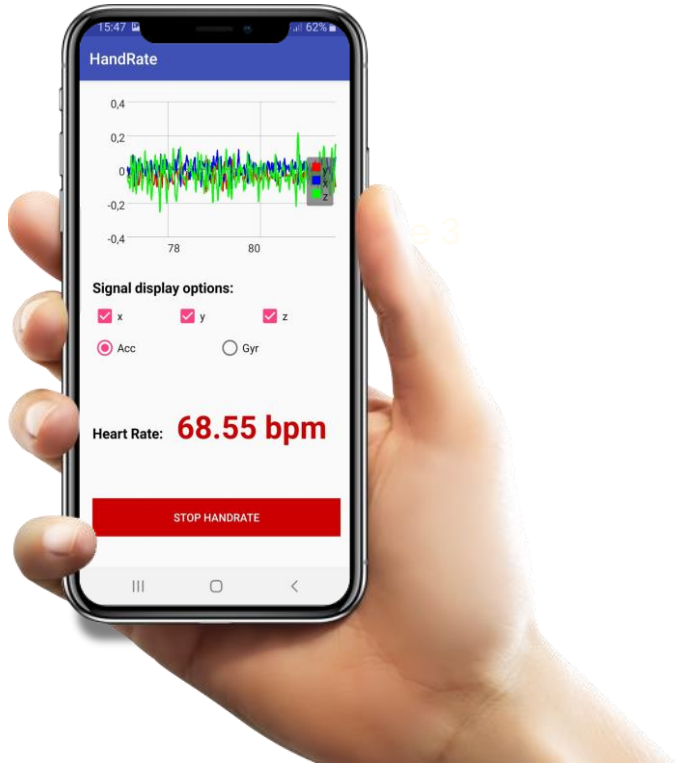
Feasibility study

Design of a system to perform this task

Performance evaluation - *Error comparable to other techniques and performs well under different experimental conditions*

Future work

More diverse data collection and evaluation (large period of time in daily life, phone models, non-healthy subjects)



USES OF WEARABLE TECHNOLOGY


Thank
you