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ObeSense RTD 2013

FNSNF

Touch-Based System for Hemodynamic Parameters Estimation

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MOTIVATION

Congestive heart failure

- Heart fails to pump enough blood.
- Causes : High blood pressure, tobacco, lack of sport.
- Symptoms : Fluid increase in the thoracic cavity

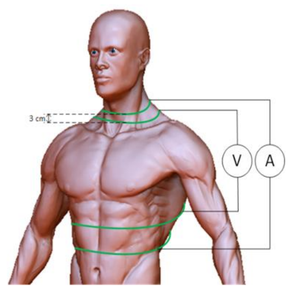
Prevention - Hemodynamic parameters estimation

- Invasive method
  (Medically approved, hospital use, expensive)
- Non-invasive method : Impedance Cardiography (ICG)
  (Medically unapproved, simple, cheap)

Non-invasive assessment of parameters through ICG !

IMPEDANCE CARDIOGRAPHY (ICG)

- AC current is passed across the body
- Current path depends on the frequency
- $Resistance \sim \frac{1}{volume\ that\ contains\ water\ \&\ electrolytes}$
- $Voltage = Z * Current, Z - bioimpedance$
- $ICG = -\frac{dZ}{dt}$



Traditional setup

ICG is linked to the fluid level !

ICG DEVICES AND MAIN CONTRIBUTIONS

ICG Devices

- Philips ICG monitor [1]
- Multi-Parameter Patient Monitor [2]
- Measuring board based on ECG/ICG [3]

Disadvantages :

- Sensing electrodes placed on the body
- Lack of portability

Unsuitable for ambulatory & home-based monitoring !

Main Contributions

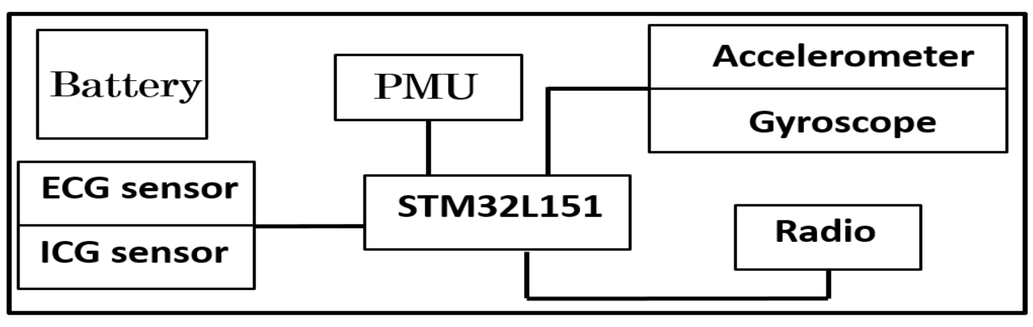
- Touch-based device for ECG/ICG acquisition
- Real-time algorithms for embedded filtering
- Hemodynamic parameters estimation

TOUCH-BASED ULTRA-LOW POWER DEVICE

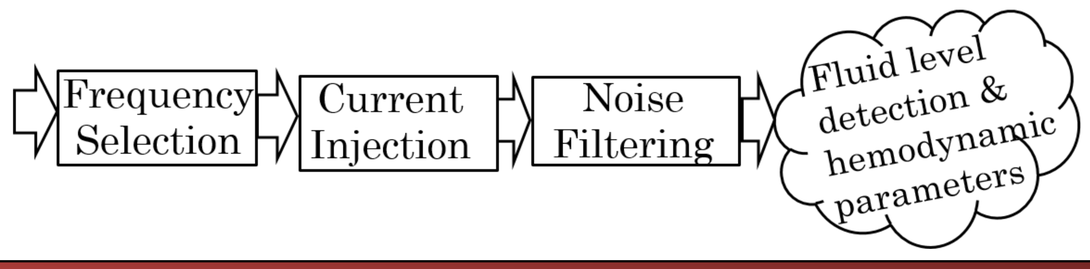
Device

- Real-time ECG/ICG acquisition
- Adjustable frequencies :
  - ✓ Sampling frequencies
  - ✓ Frequency of injected current

Node architecture

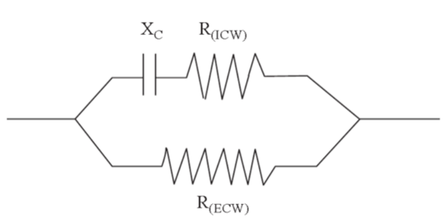


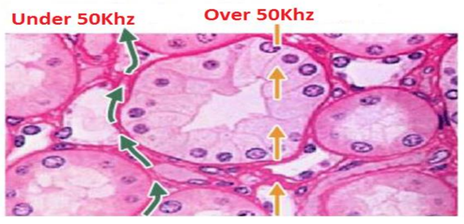
Software component



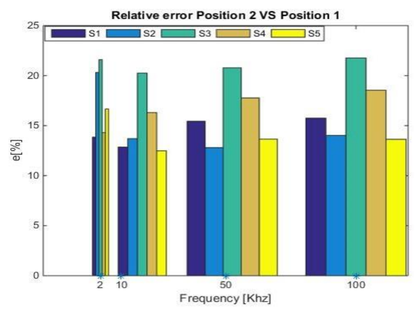
EXPERIMENTAL DETAILS AND RESULTS

- 5 male subjects, 3 different positions
- $f_{injected\_current} \in \{2, 10, 50, 100\} Khz$



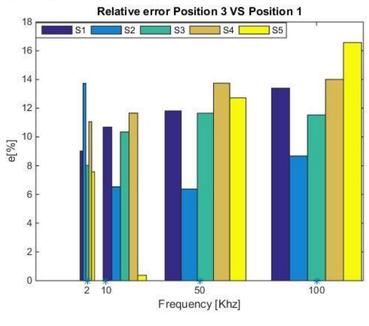


Equivalent circuit of the body and current flow [4]



S - Subject

Reasonable error due to hands shaking !



CONCLUSIONS

- **Real-time ICG/ECG signals acquisition**
- **Touch-based portable ultra-low power device**
- **Correlated with the traditional setup (> 80%)**

REFERENCES:

[1] “Philips.” [Online]. Available: http://www.medical.philips.com/
[2] “CAS Medical LIFEGARD II.” [Online]. Available: http://www.medwrench.com
[3] S. Weyer et al., “Development of a wearable multi-frequency impedance cardiography device.” Journal of medical engineering & technology, vol. 39, no. 2, pp. 131–7, Feb. 2015.
[4] U. G. Kyle et al., “Bioelectrical impedance analysis–part I: review of principles and methods.” Clinical nutrition (Edinburgh, Scotland), vol. 23, no. 5, pp. 1226–43, Oct. 2004.