Medical Data Over Sound - HealthTalk Concept

Radovan Stojanović
Faculty of Electrical Engineering & MECOnet
University of Montenegro
Podgorica, Montenegro
stox@ucg.ac.me

Mihailo Vukmirović
Clinical Centar of Montenegro
Podgorica, Montenegro
mihailov@ucg.ac.me

Vesna Miranović
Faculty of Medicine
University of Montenegro
Podgorica, Montenegro
vesnami@ucg.ac.me

Jovan Đurković
MECOnet d.o.o.
Podgorica, Montenegro
jovan@meconet.me

Blagoje Babić
Clinical Centar of Montenegro
Podgorica, Montenegro
blagoje.b@ucg.ac.me

Content

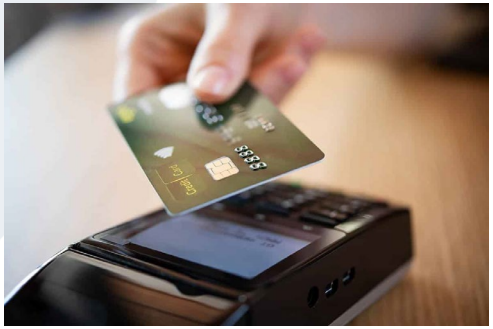
- Problem definition
- State of the art
- Methodology/Solution
- Results
- Conclusion

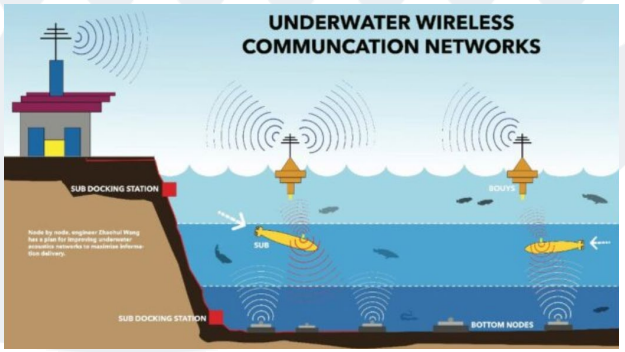
Problem definition

- **Medical Data over Sound (MDoS), HealthTalk (HT) Proof of Concept.**
- Can we transmit medical signals via air?
- If we can, how to do it in the most efficient way by applying state of the art technologies?
- What are the advantages of such a solution?

State of the art

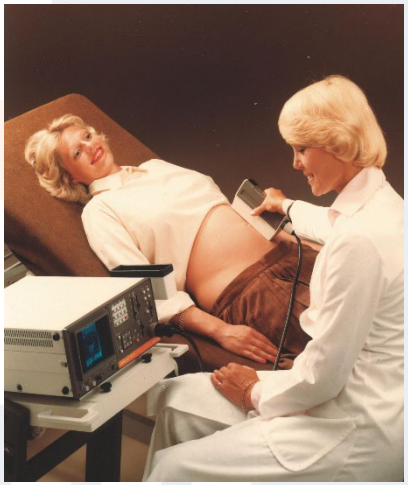
- Since the existence of civilization, information has been transmitted via sound.
- Through the ages in different ways.
- Language emerged as a revolutionary means of transmitting knowledge, emotion, and culture.

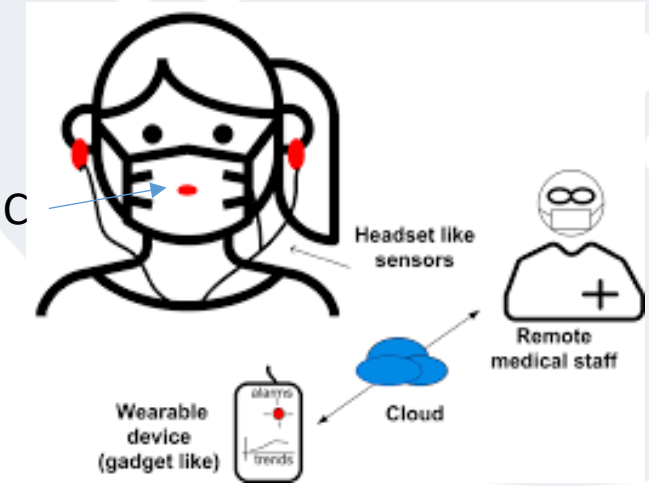




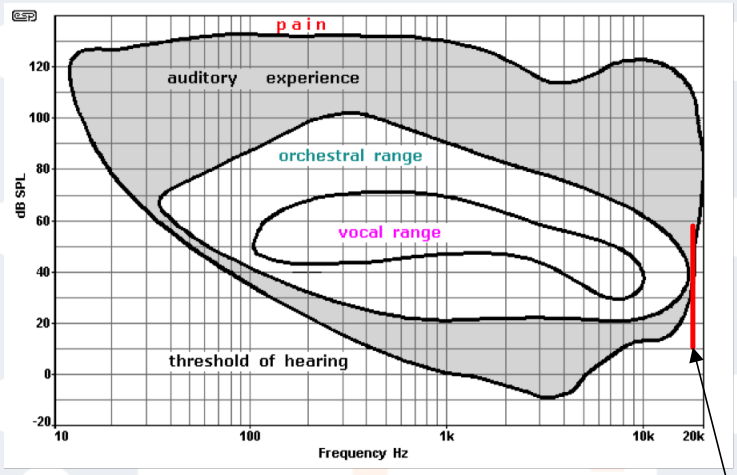
State of the art

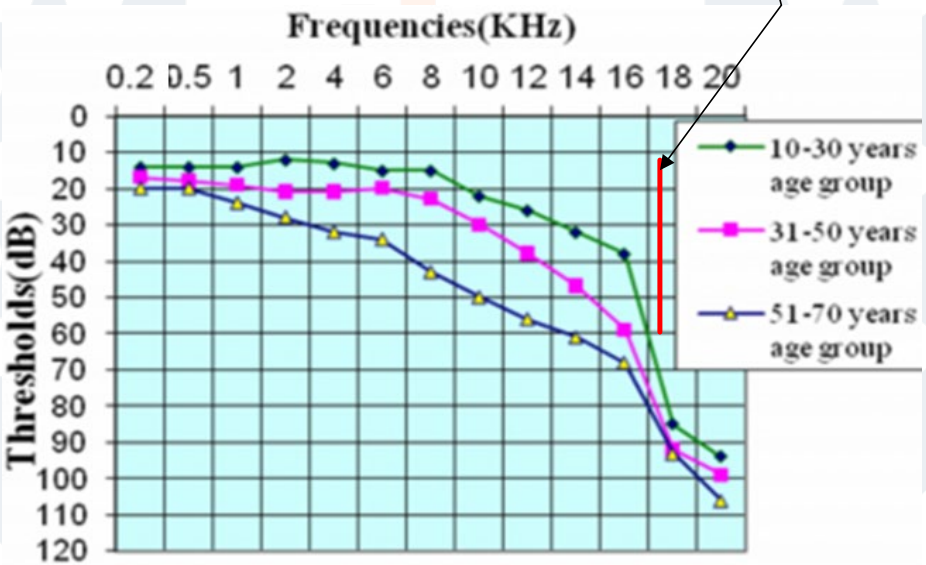
- Using sounds in medicine is applied in many fields on direct way, as listening to respiratory and heart sounds, gastro auscultation, ultrasound, for COVID-19 detection etc.





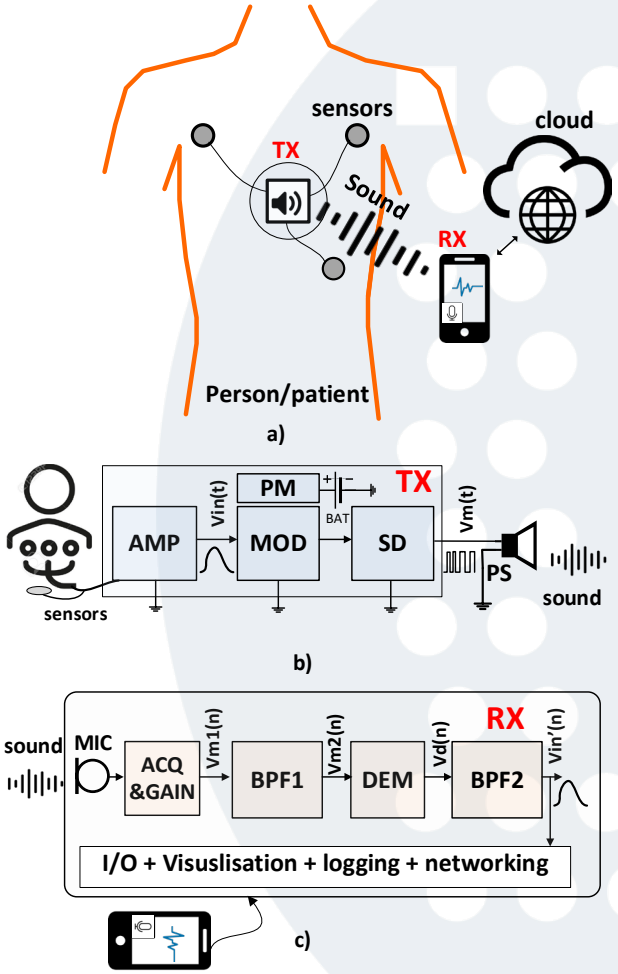
Methodology/Solution/PoC



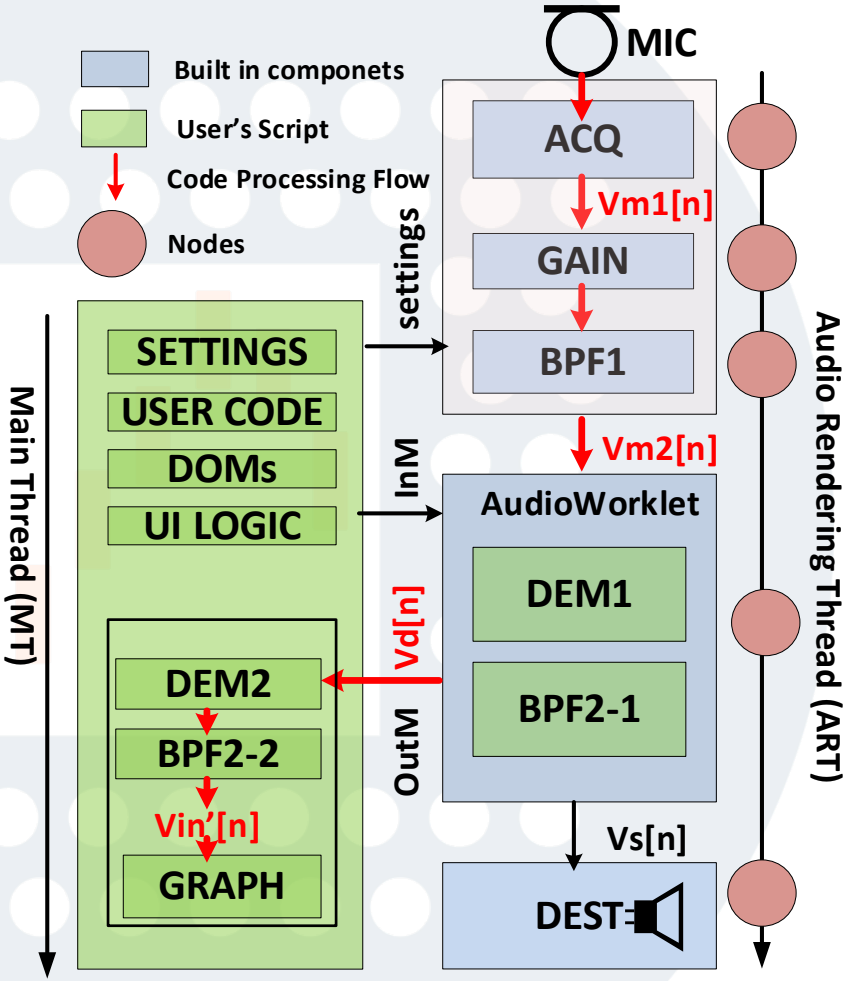


Selection of the working conditions

PoC

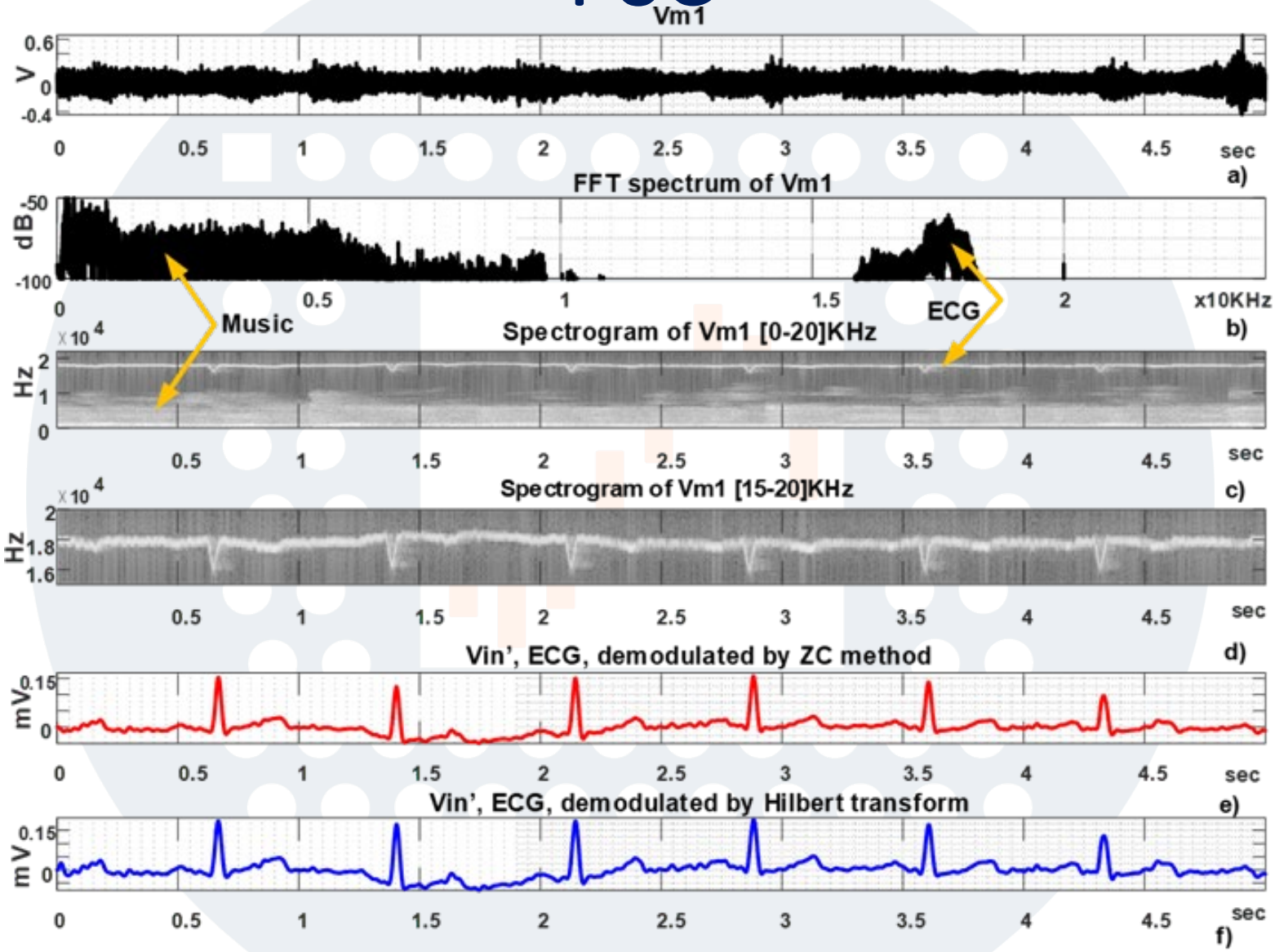


Architecture of HealthTalk a) Global b) Electronics



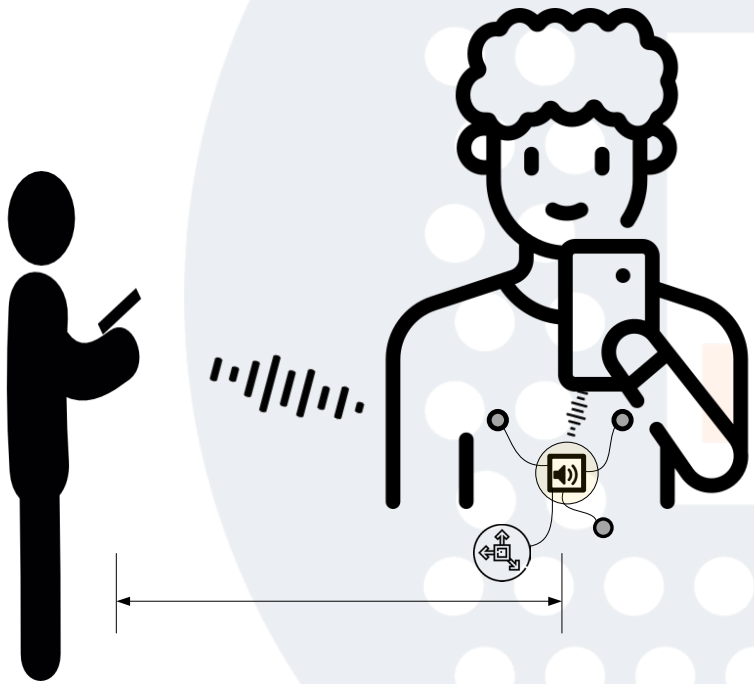
Software decoding architecture (JavaScript+HTML+CSS+AudioAPI

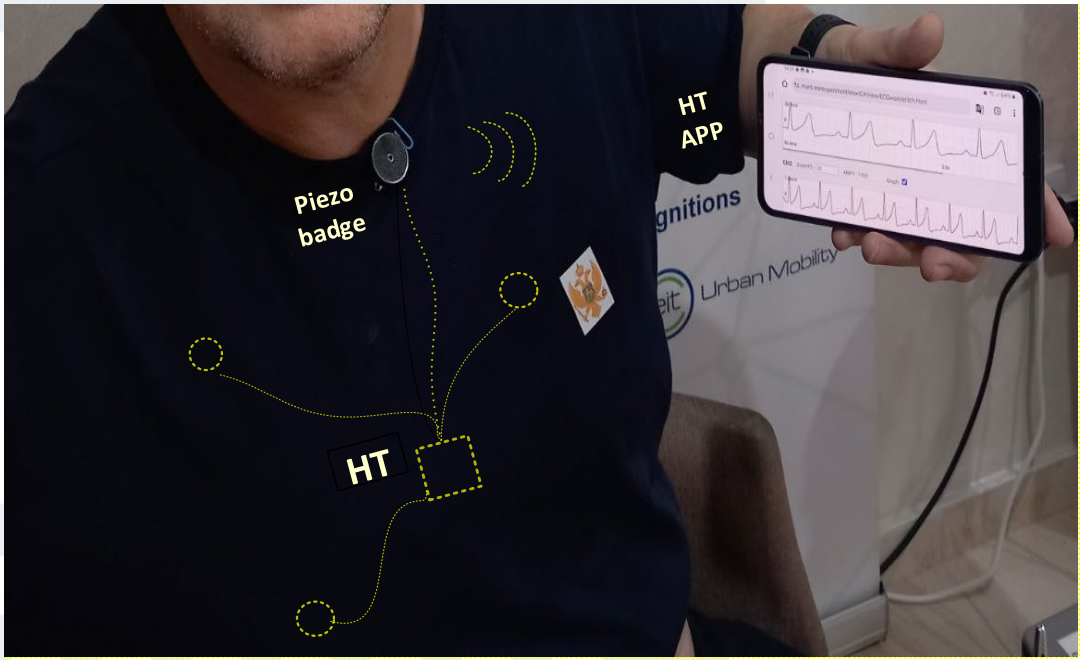
PoC



Signal processing steps on RX side, time (a), frequency (b), time-frequency (c,d) domains and demodulation by ZC and Hilbert

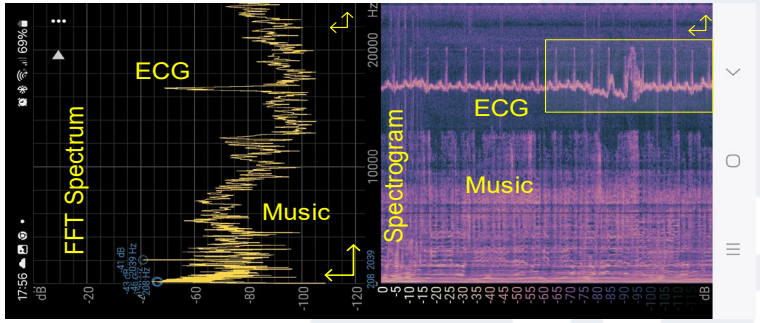
Testing results





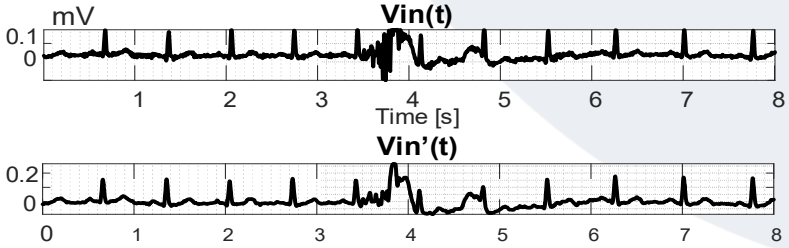
Testing scenario a), system demo b)

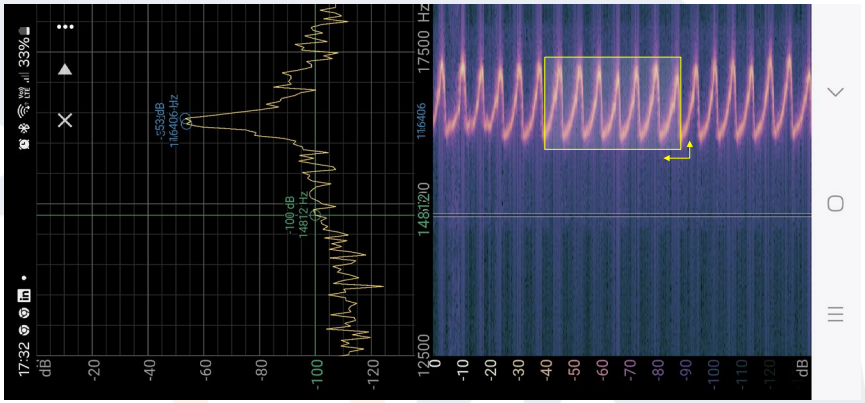
Testing results



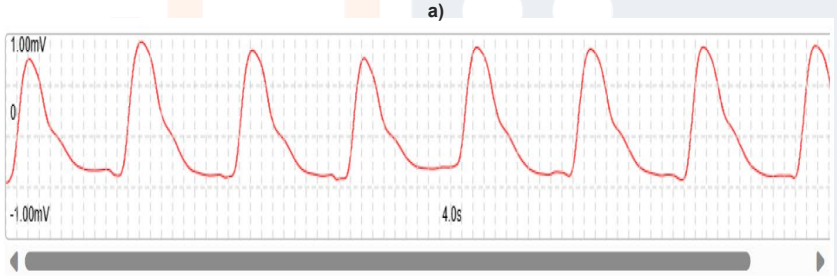
a)

b)





a)

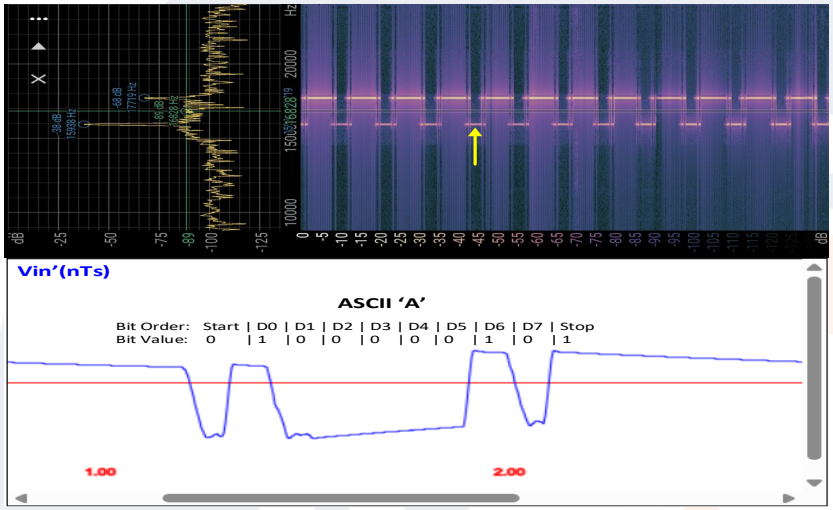


b)

Time, frequency and time-frequency domains are considered, left **ECG** case, right **PPG**

a) FFT and STFT spectrums,
b) demodulated signal by HT APP,
c) up original ECG signal on the input of transmitter,
d) down reconstructed ECG signal on the output of receiver.

Testing results



Medical Digital Data over Sound

Consumption

BAT Voltage/ Power consumption in mW	VCO 4046 based modulator	ATMEGA328 based modulator
9V, 3.3 Vpp on piezo speaker	15.5 mW	34 mW
9V, 5 Vpp on piezo speaker	20 mW	70 mW
9V, about 9 Vpp on piezo speaker	35 mW	90 mW

Conclusion

- **MDoS** suppress the gaps in **Edge IoT** where traditional wireless tech is impractical, costly, or restricted.
- **Advantages:**
  - ultra-low consumption, enhanced comfort, passive transmission, short-range, hard-to-hack, transmit analog and digital data with the same tool, good for sensitive environments like ICUs, MRI rooms, Cars, Airplane, by default compatibility, zero setting, works in RF-restricted areas as water, underground facilities, eco friendly, no health risk
- Disadvantages:
  - lower bandwidth than BLE/Zigbee (limited data rates), limited channels, shorter range, in audio range sensitivity to ambient noise (not case for ultrasonic), line-of-sight or controlled environment often needed for reliable transmission.

Demo links

- Demo off-line
- Demo on-line
- Demo Internet (only for android)

ACKNOWLEDGMENT

This Project is supported by
Innovation Fund of Montenegro
under Grant POC-028-24
for whose support the authors are very grateful.

Thank you, Q&A?