Mobile platform electrocardiogram wavelet analysis system with Sailfish OS

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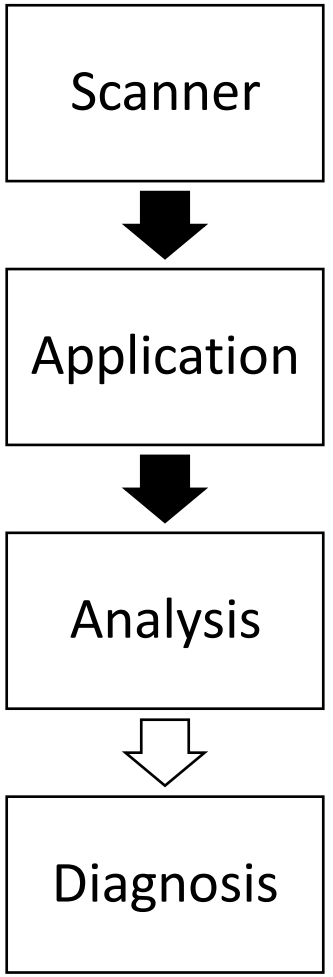
Preface

Mobile health monitoring:

- Smartwatches
- Wristbands
- Individual scanning devices

Goals

- Develop ECG scanning and transmitting device
- Implement an application which performs CWT and further analysis of ECG
- Make it possible for regular users to understand the results of application's work



Electrocardiography

- Main method for diagnosing cardiovascular system
- Absolutely safe to perform
- Diagnoses are based on shape and duration of intervals

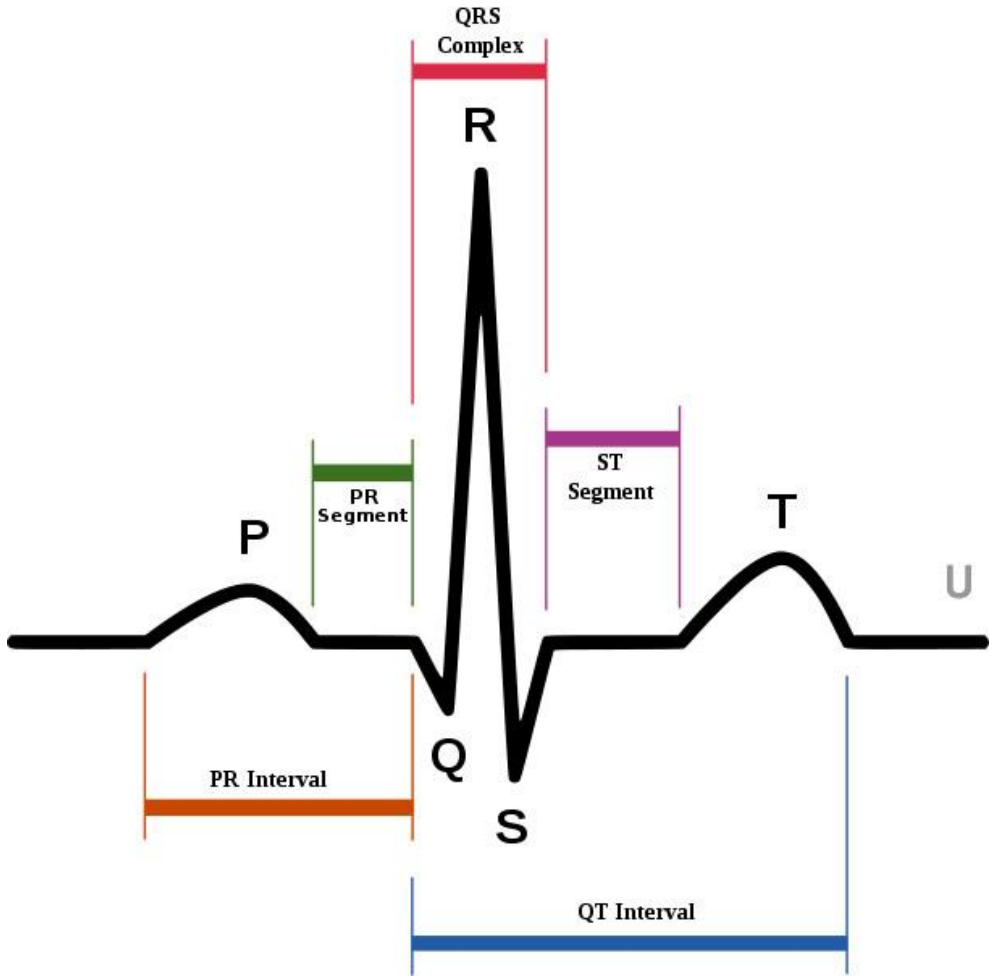


Fig. 1. Intervals of ECG period

Wavelet Analysis

- Wavelet – special function localized along the time axis and able to shift on it and scale
- Based on Short Time Fourier Transform to improve its accuracy
- Divided into Discrete Wavelet Transform and Continuous Wavelet Transform
- Useful for signal analysis, image compression etc.
- Wavelet must be suitable for analysis

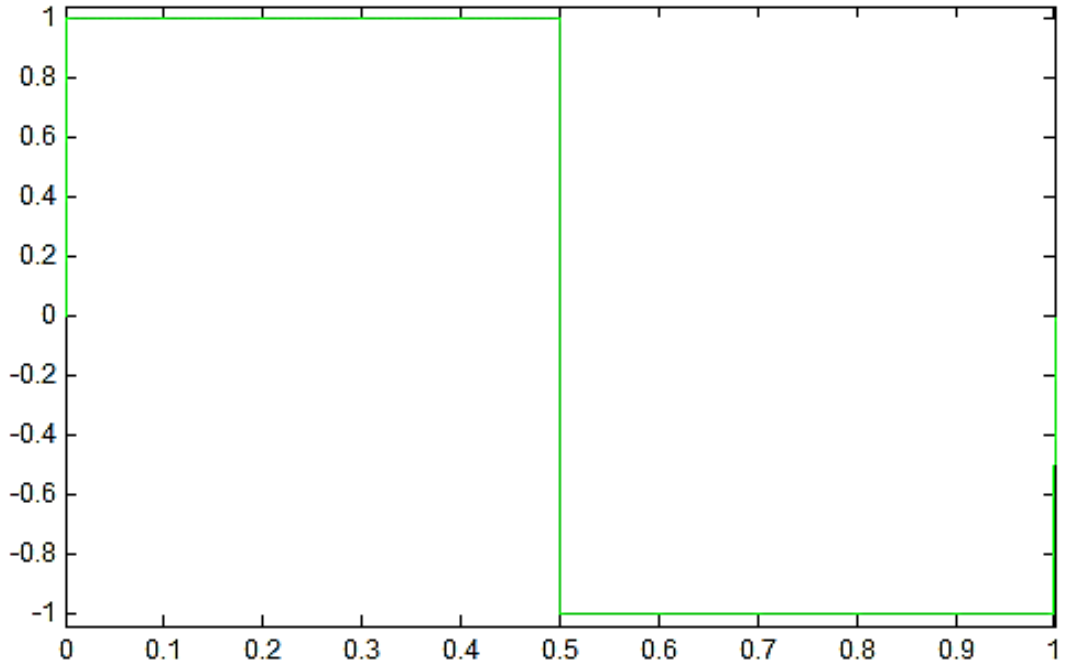


Fig. 2. Haar wavelet

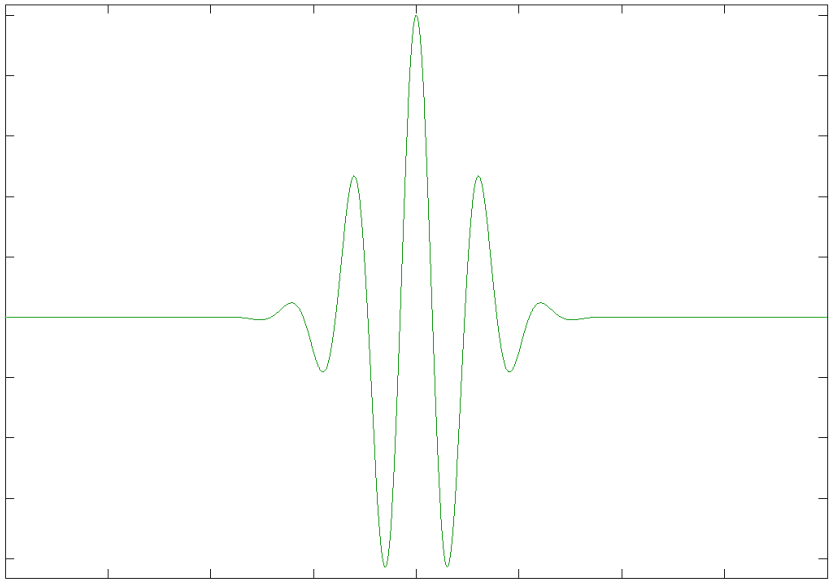


Fig. 3. Morlet wavelet

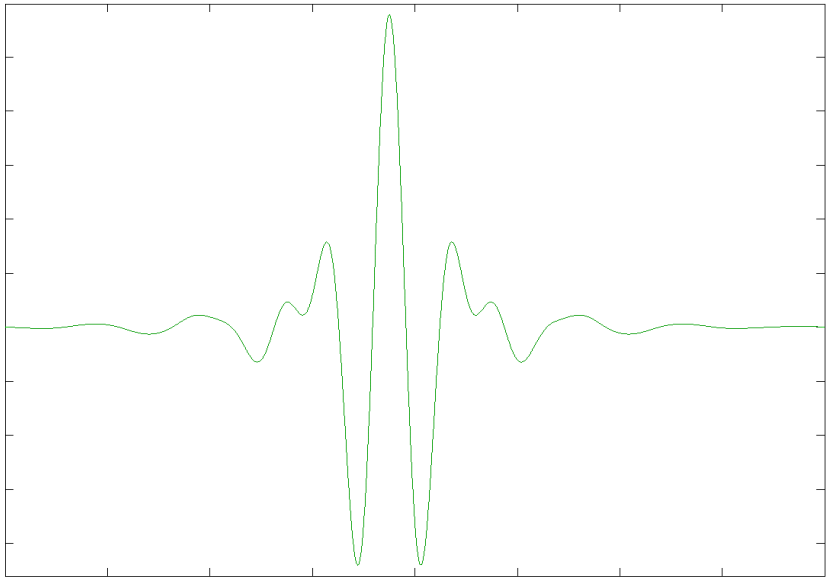


Fig. 4. Meyer wavelet

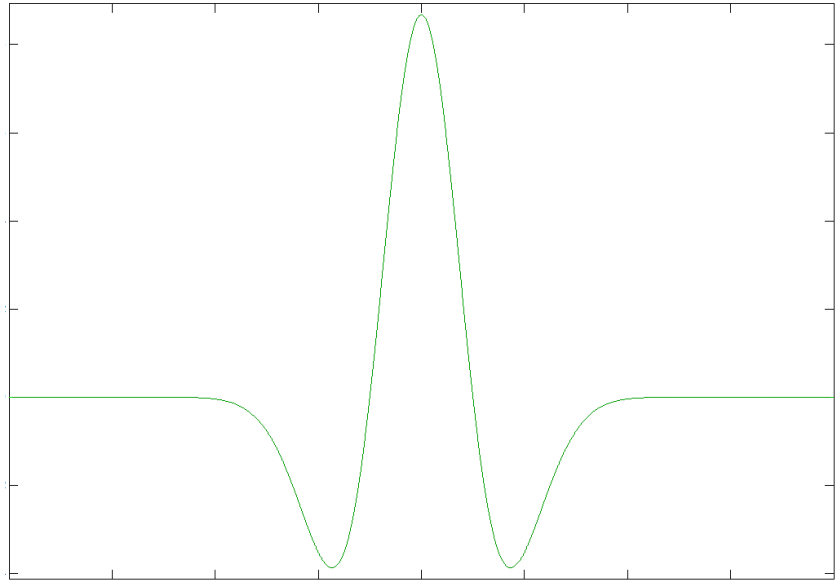


Fig. 5. Mexican hat wavelet

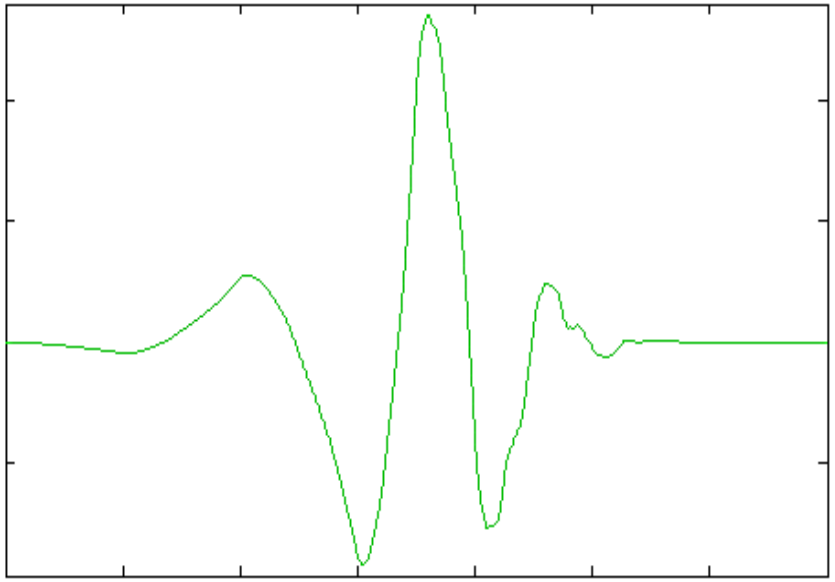


Fig. 6. db4 wavelet

Continuous Wavelet Transform

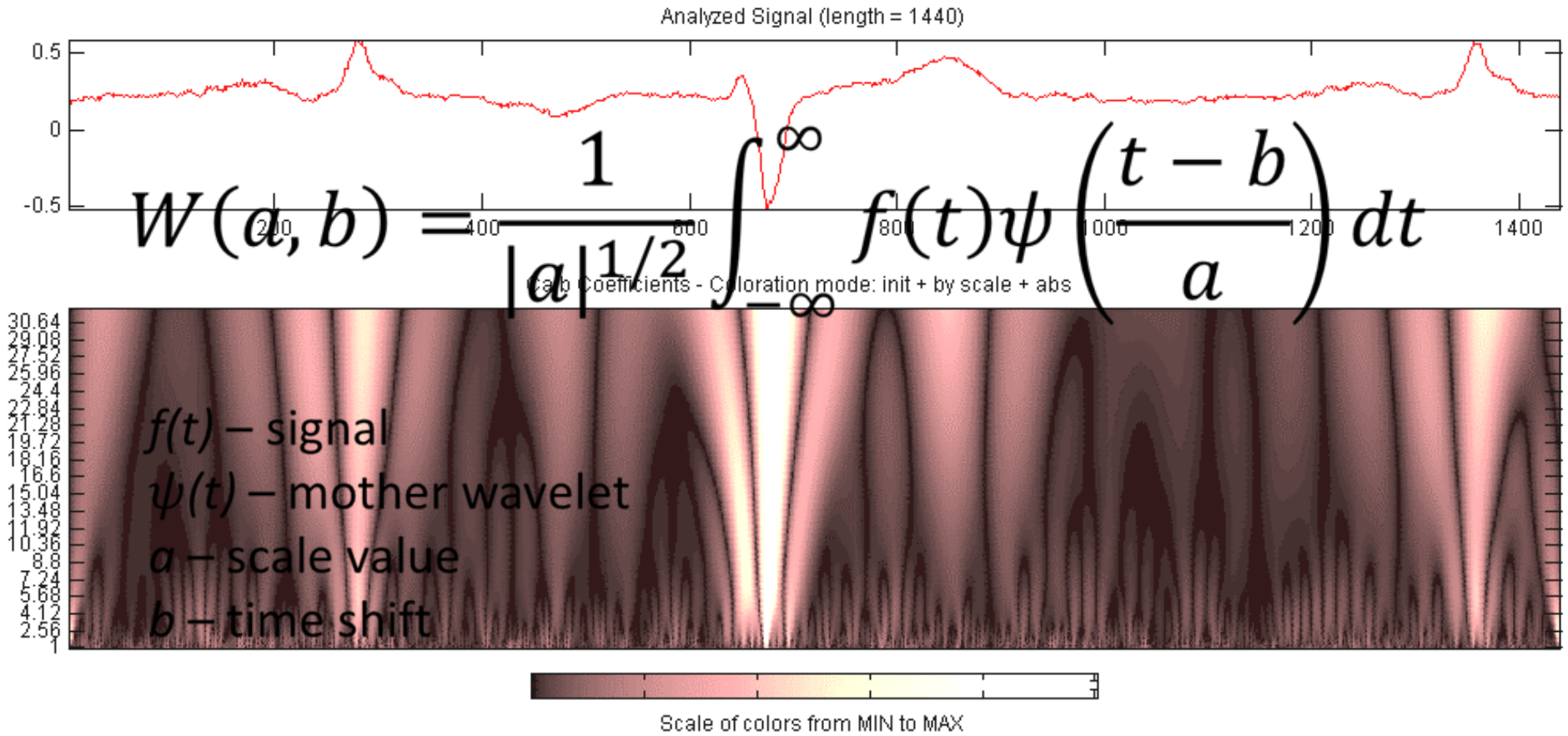


Fig. 7. ECG signal and wavelet-spectrogram in MATLAB

Why Sailfish OS?

- Original light interface
- SailfishSDK based on Qt Creator makes it possible to develop in C++ or Python
- Smartphone emulation

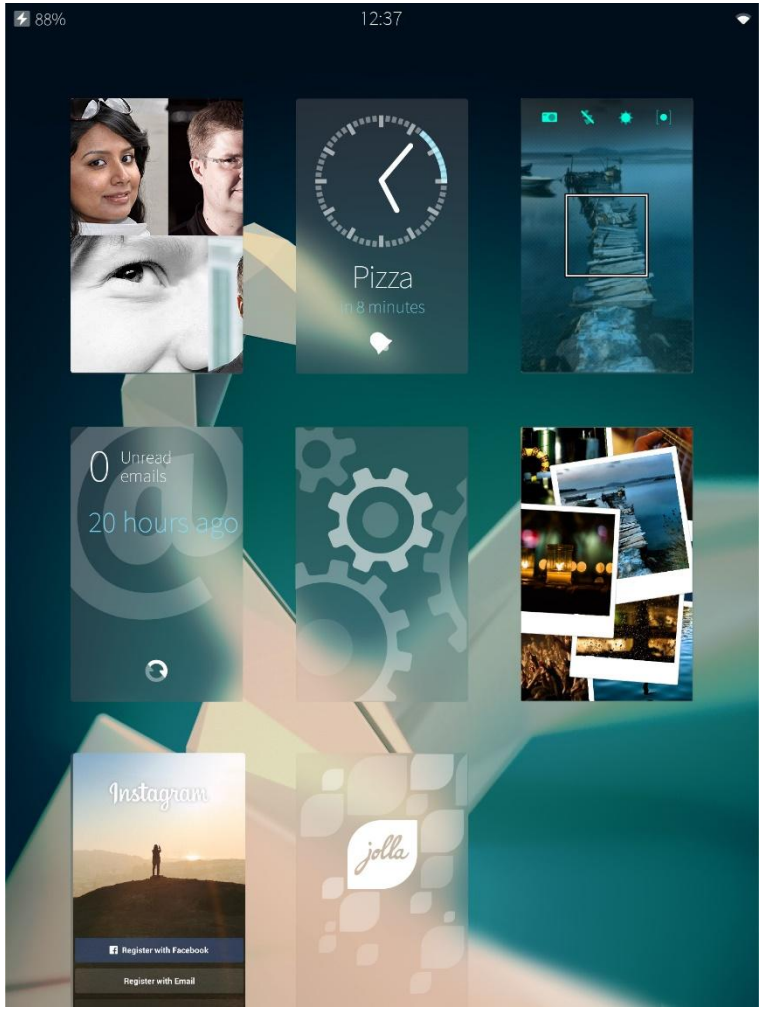


Fig. 8. Sailfish OS Home screen

Application

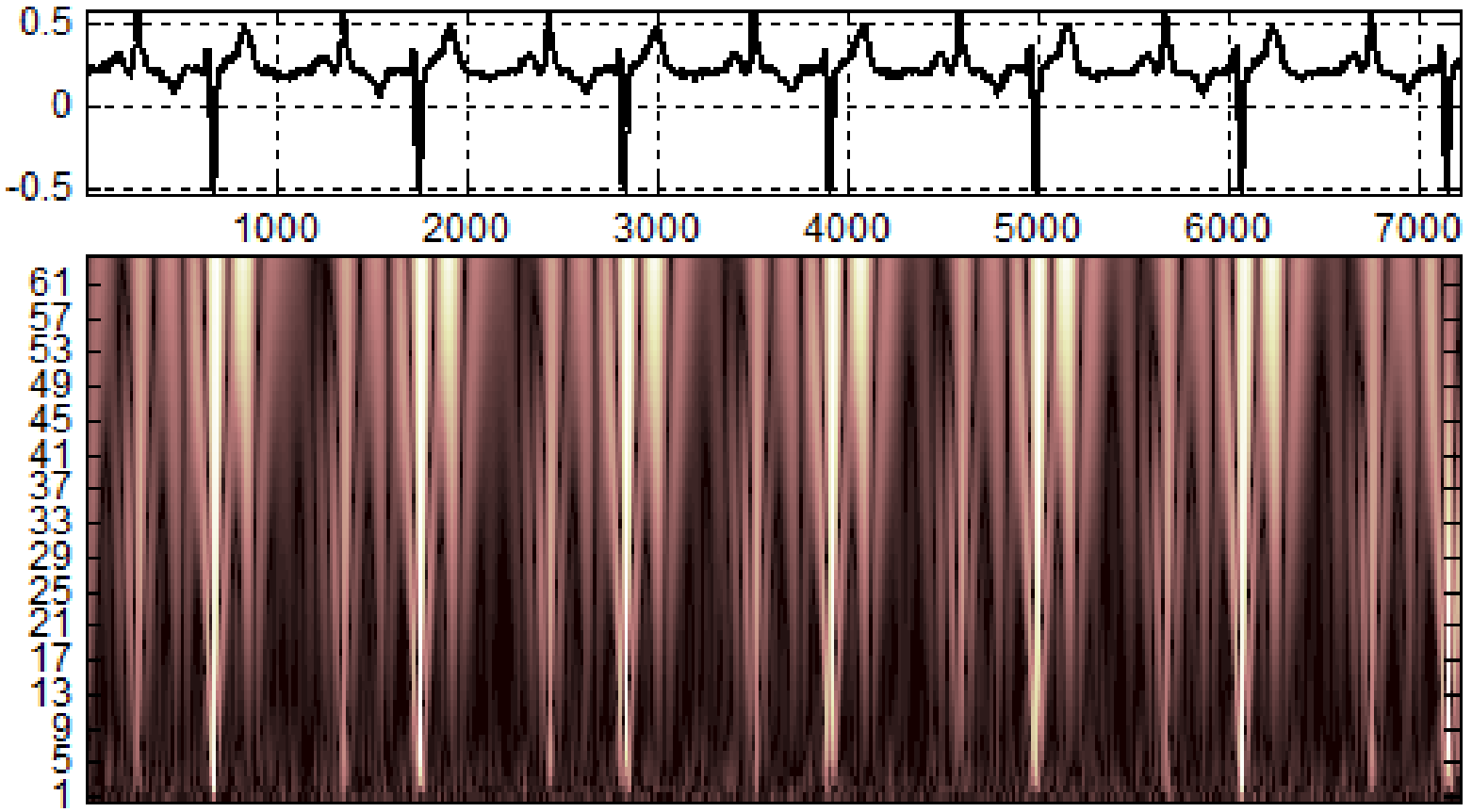


Fig. 10. Wavelet-spectrogram in MATLAB

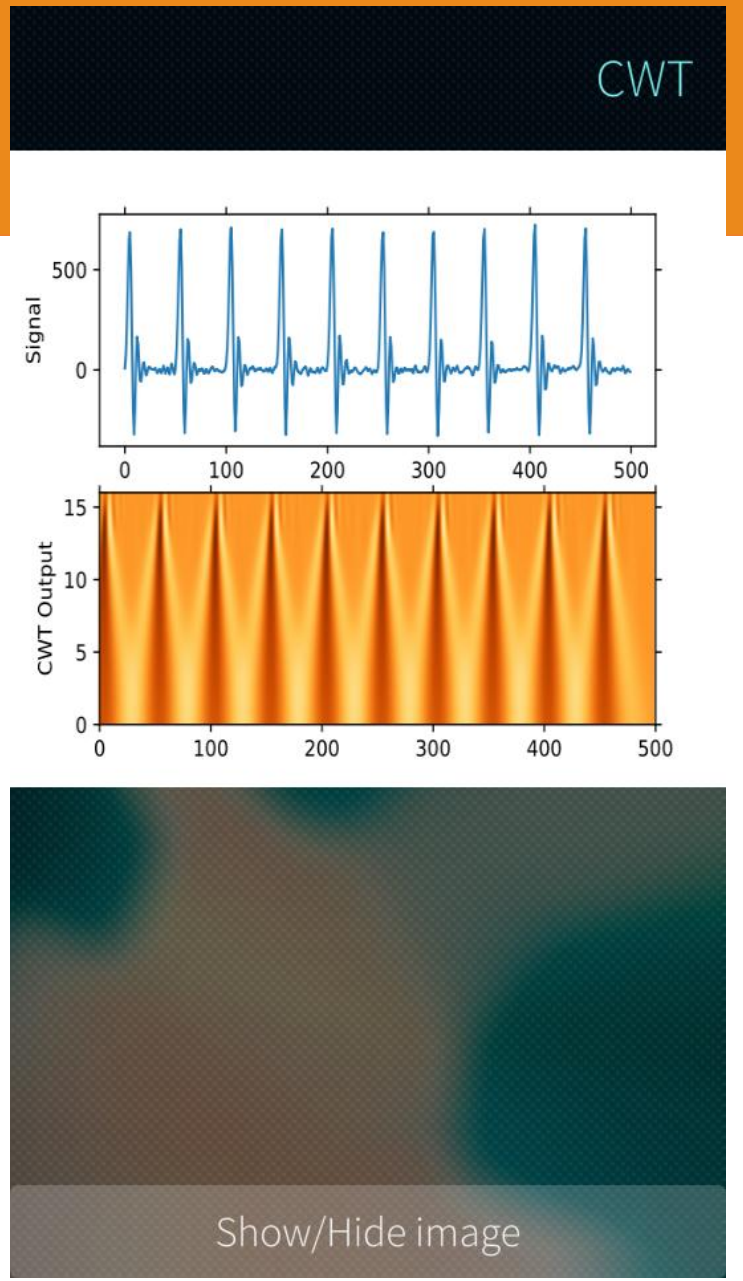


Fig. 9. Application in VirtualBox

Conclusion

CWT application was developed on Sailfish OS

Problems:

- Low-resolution wavelet-spectrogram does not provide much information about ECG signal
- It is hard to estimate the resources usage by real smartphone

Future work (in addition to finding solutions of existing problems):

- Developing scanning device
- Implementing application on the real smartphone
- Making application more user-friendly

Sources:

https://physionet.org/physiobank/

https://sailfishos.org/

MATLAB Wavelet Analysis App

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