Unobtrusive, Mobile ECG Monitoring and Arrhythmia Detection using Mobile Phones

Heike Leutheuser, Patrick Kugler, Stefan Gradl, Dominik Schuldhaus, Stephan Achenbach, Bjoern Eskofier

05.12.2013

Pattern Recognition Lab (CS 5)

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

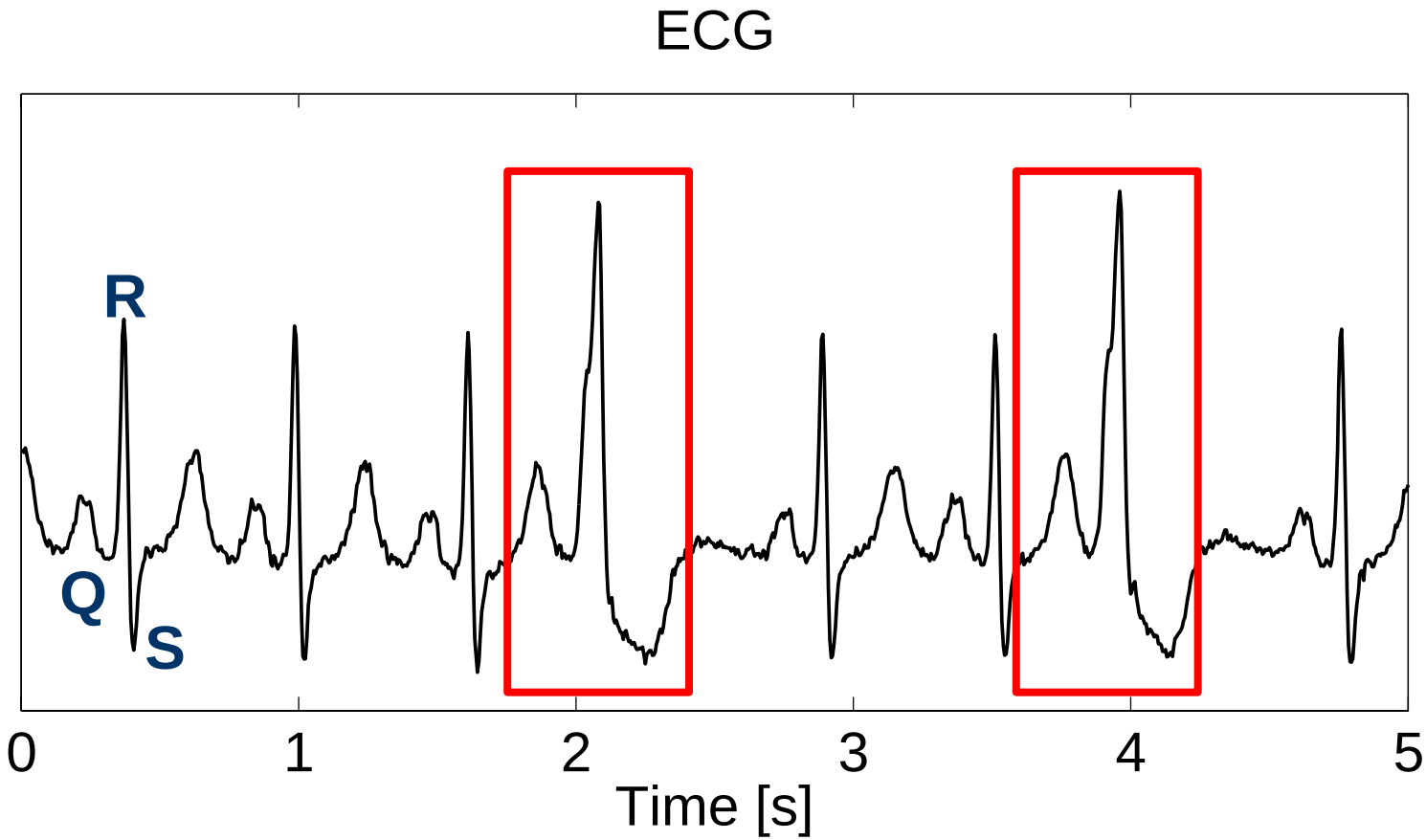
TECHNISCHE FAKULTÄT

World Health Organization

Cardiovascular diseases:
Number one cause of death globally

Electrocardiogram (ECG)

= electric activity of the human heart



Use of ECG

Cardiac Conditions

Need for long-term analysis

Detection

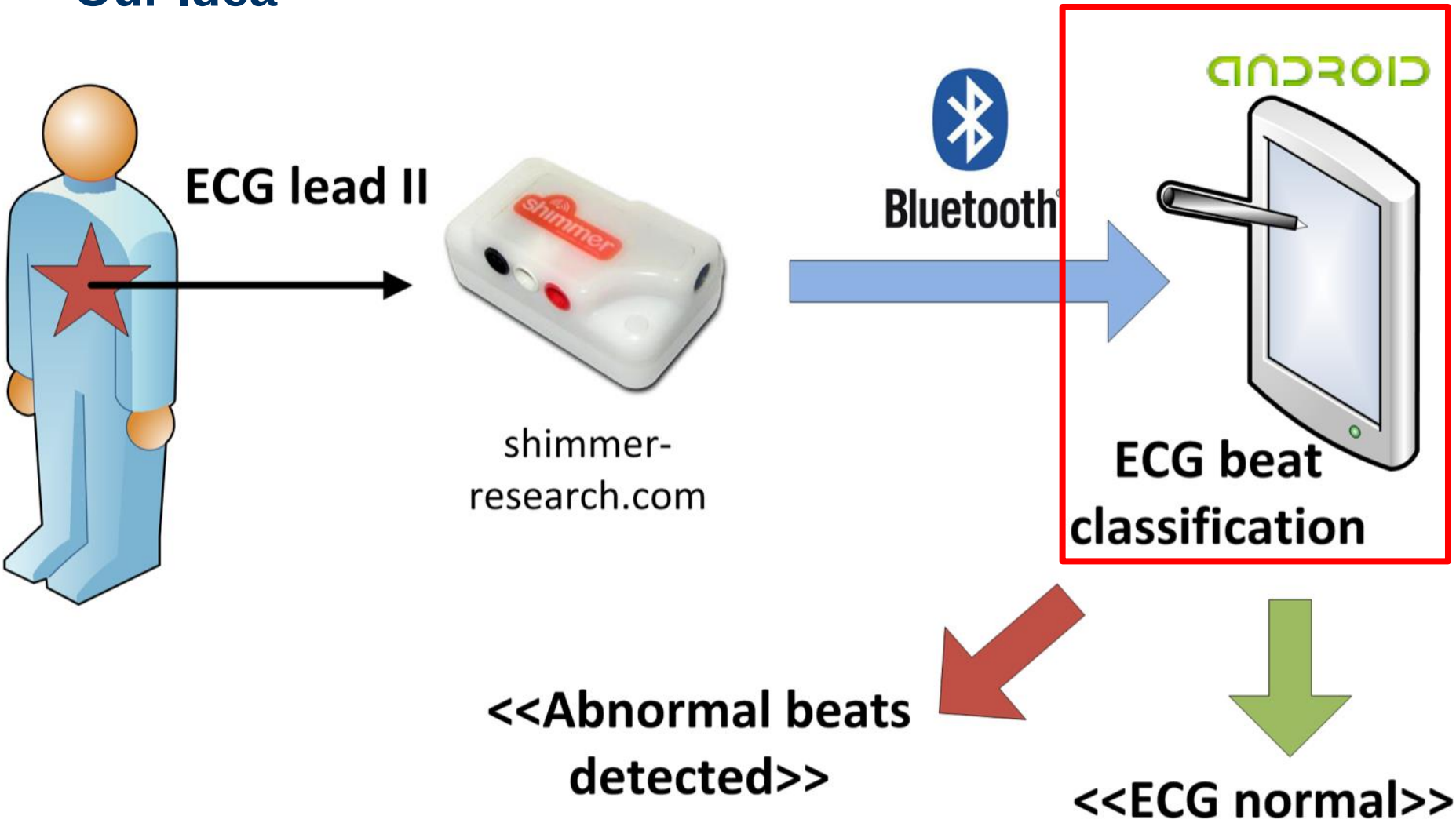
Monitoring

Prevention

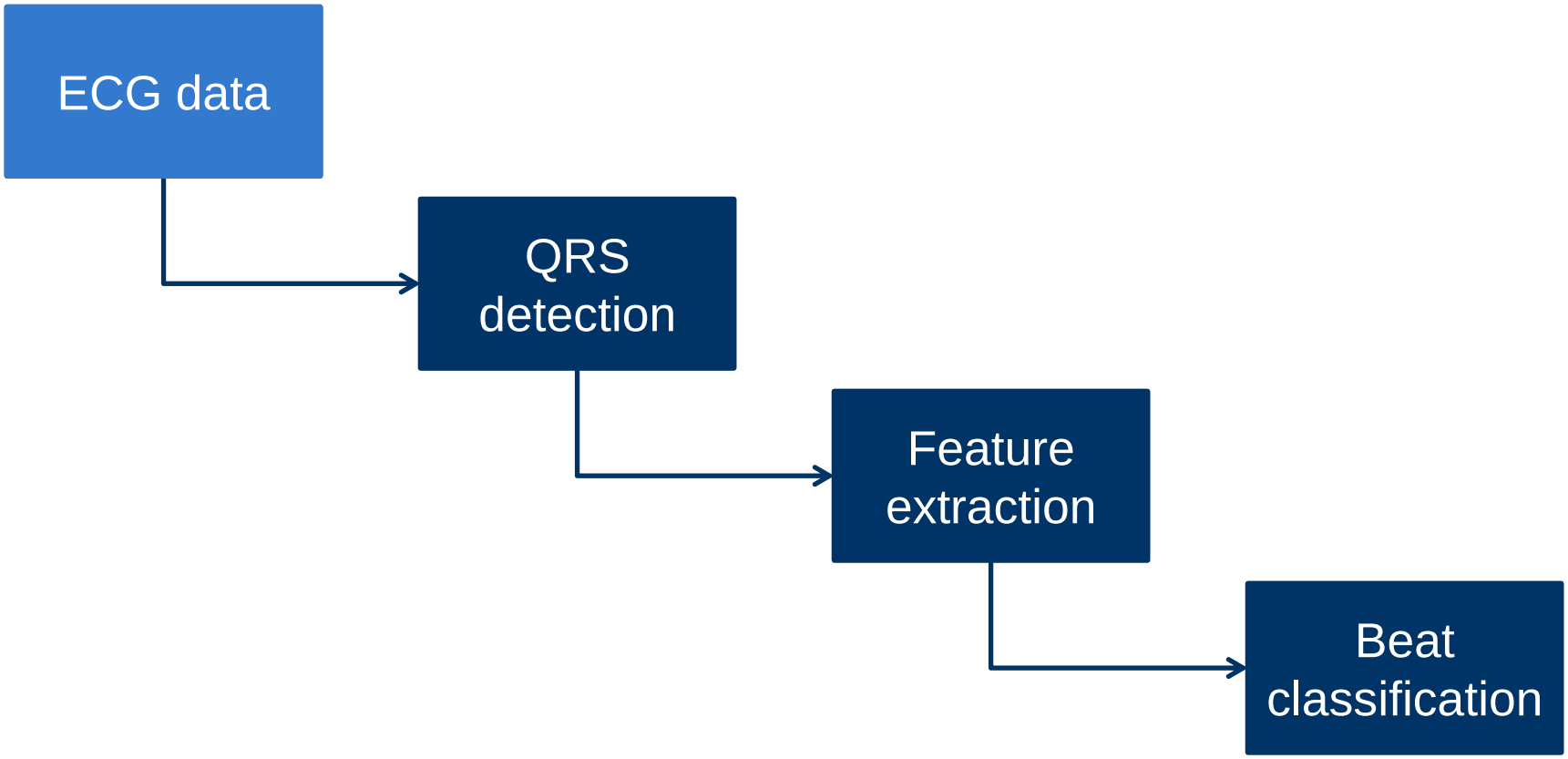
Measuring of ECG

- Problems:
  - Specific hardware
  - Interpretation limited to medical personnel
- Need for:
  - Automatic, low-cost solution
  - Portable solution (for home environment)
  - → **Mobile devices**

Our Idea

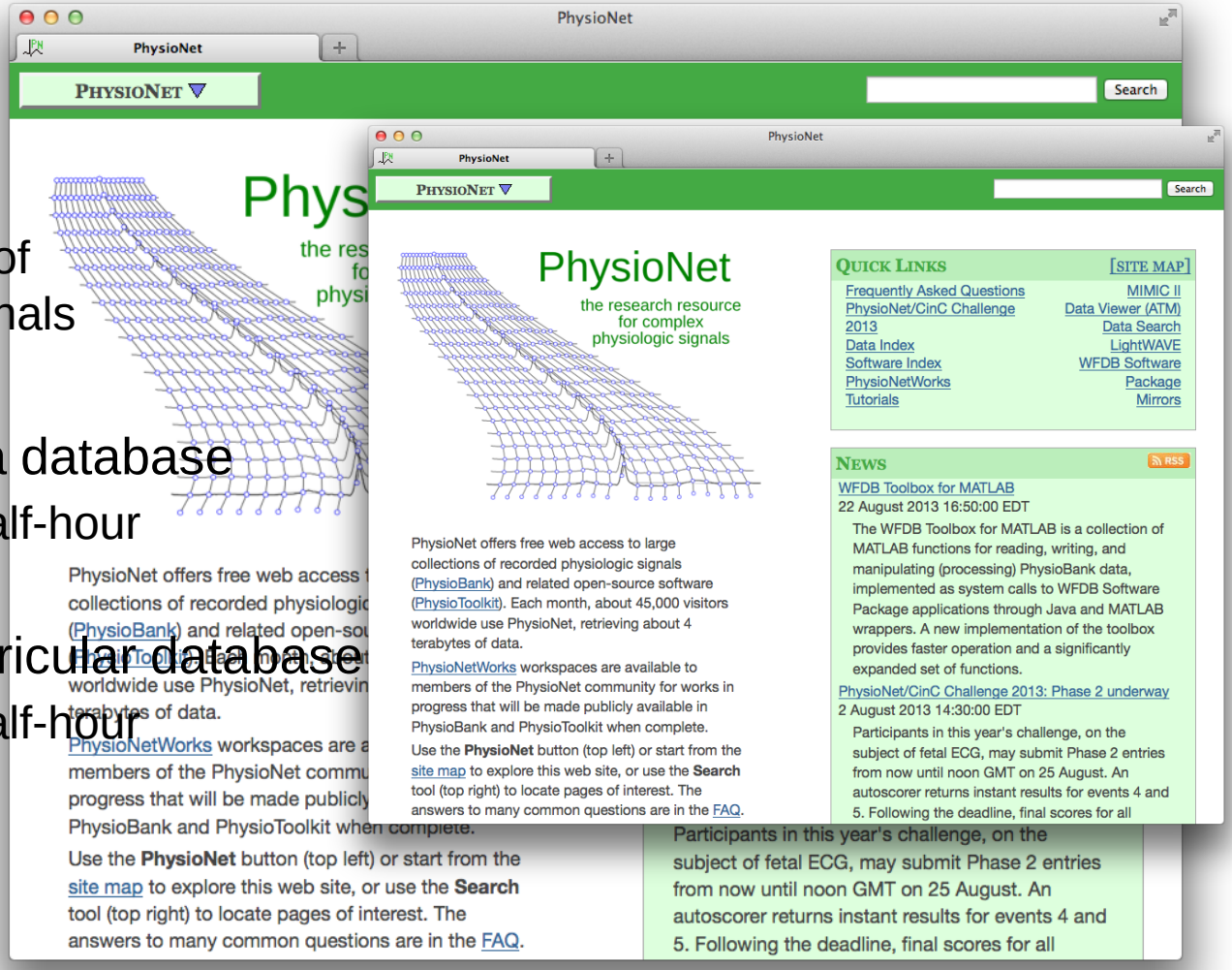

ECG lead II
shimmer
shimmer-
research.com
Bluetooth
android
ECG beat
classification
<<Abnormal beats
detected>>
<<ECG normal>>

Overview – Beat classification

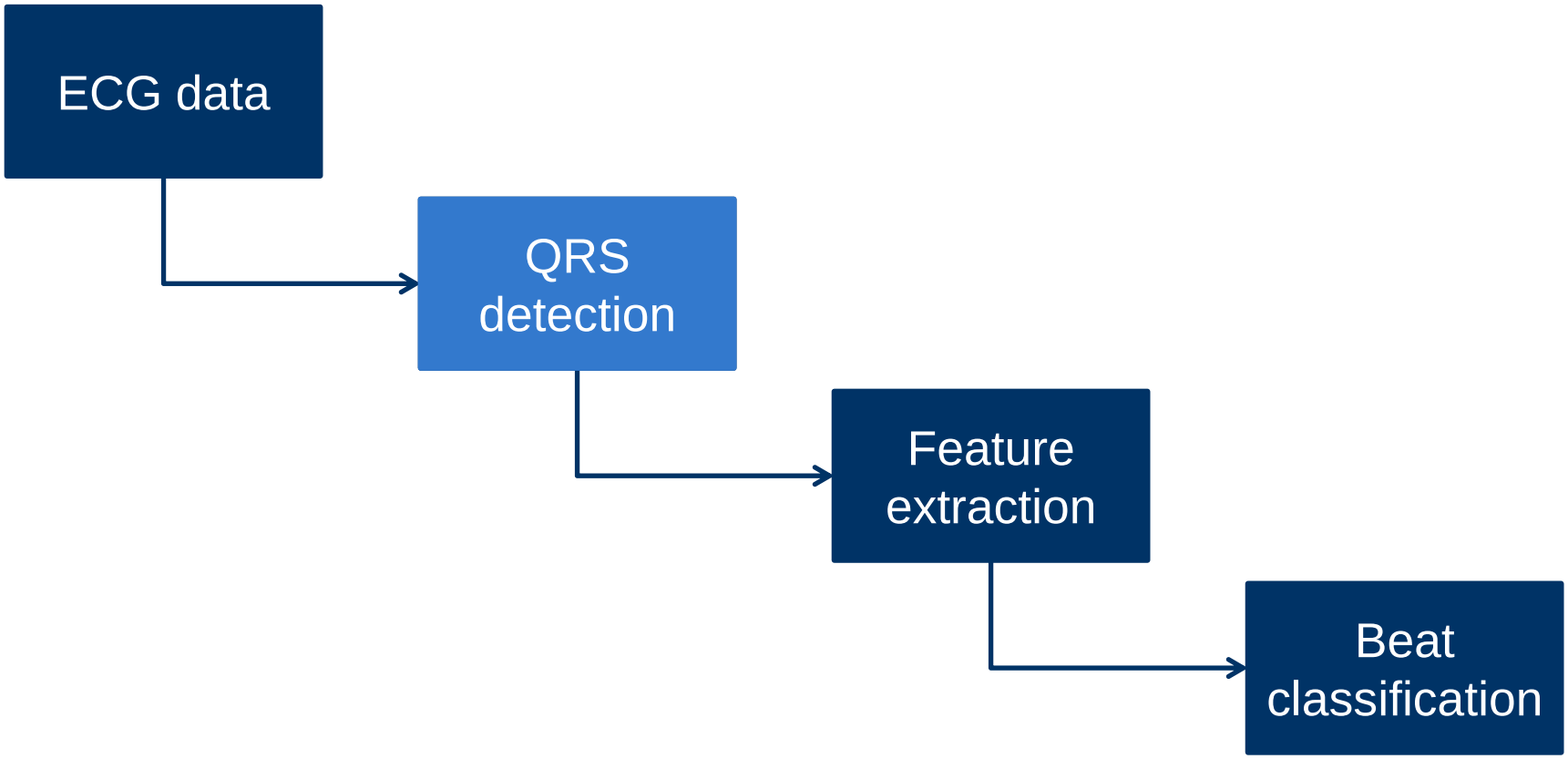


ECG Data

- Platform PhysioNet
  - Free access
  - Large collection of physiological signals
- MIT-BIH Arrhythmia database
  - 48 datasets of half-hour ECG recordings
- MIT-BIH Supraventricular database
  - 78 datasets of half-hour ECG recordings



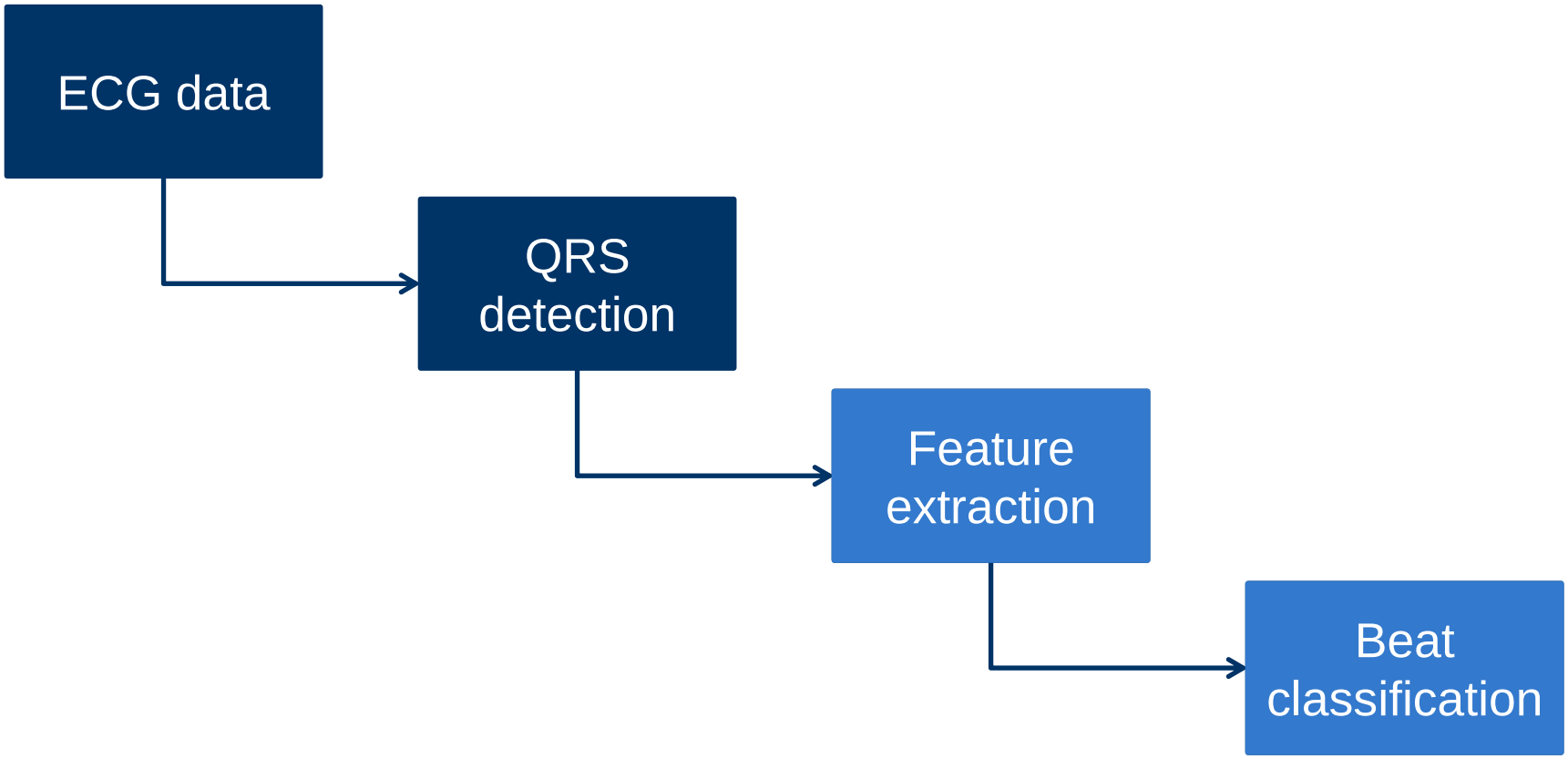
Overview – Beat classification



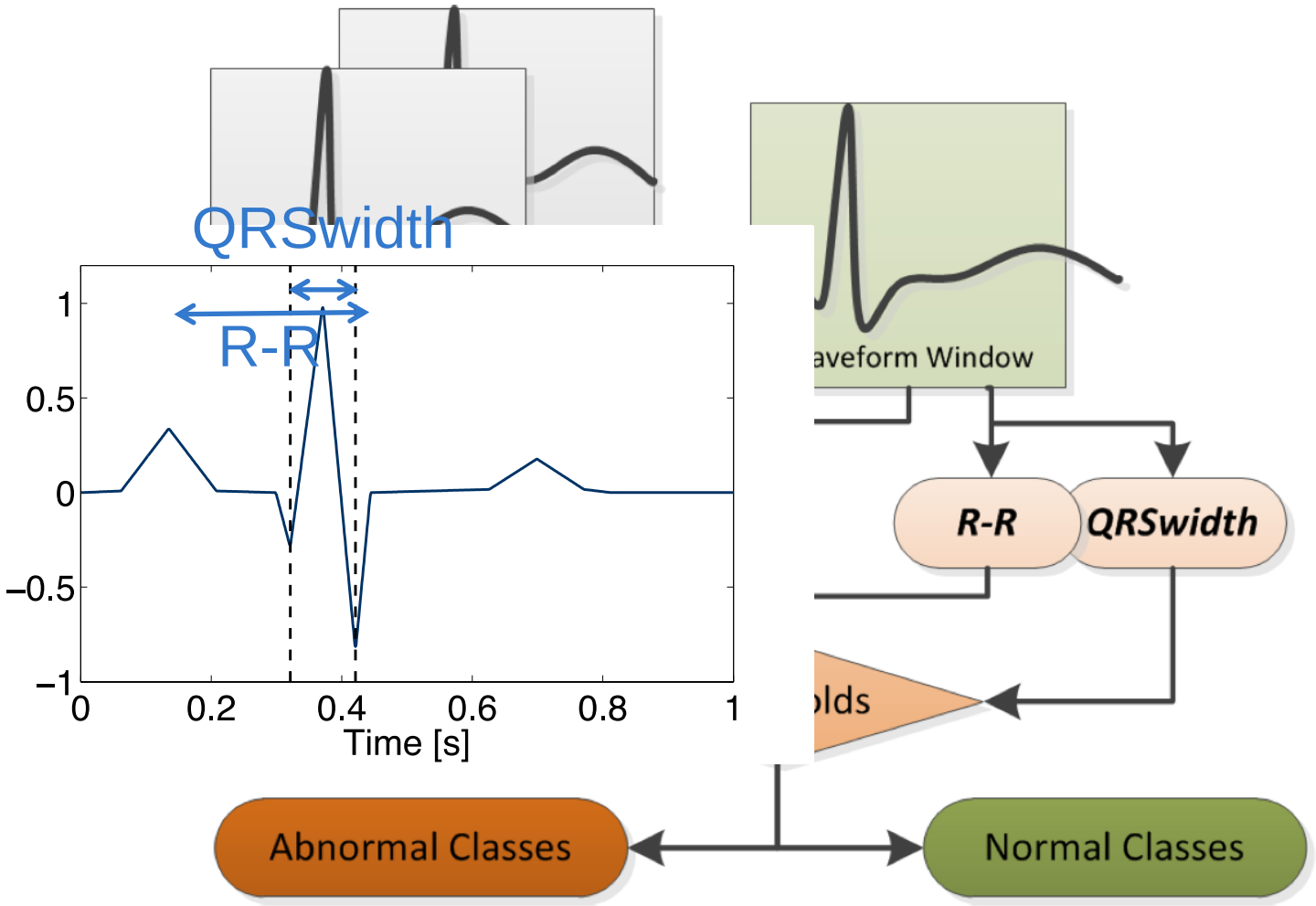
QRS Detection

Raw ECG signal (lead II) → Filter operations (Pan & Tompkins) → Threshold-based method

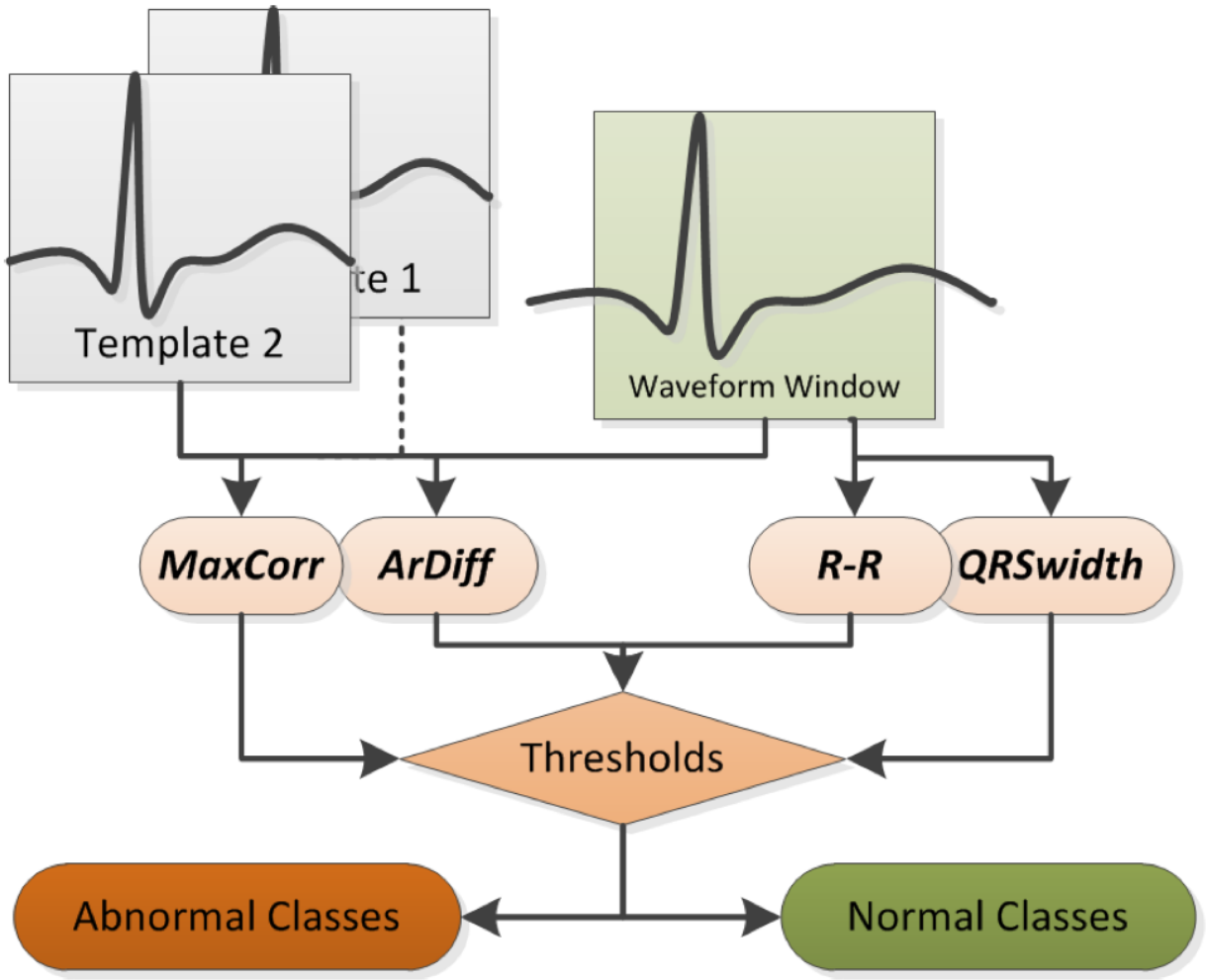
Overview – Beat classification



Classification – Decision Tree Classifier



Classification – Decision Tree Classifier



Implementation

- Java
- Android SDK

http://tinyurl.com/lmehearty

HR features

ECG signal classifcation

QRS detection

Heart rate

(Gradl et al., 2012)

Statistics

- True Positive (TP): correctly classified as normal
- True Negative (TN): correctly classified as abnormal
- False Positive (FP): incorrectly classified as normal
- False Negative (FN): incorrectly classified as abnormal

- Sensitivity = TP / (TP + FN)

- Specificity = TN / (TN + FP)

Results – Decision Tree Classifier

	MIT-BIH Arrhythmia	MIT-BIH Supraventricular
Detected Beats	99.59%	99.58%

	MIT-BIH Arrhythmia	MIT-BIH Supraventricular
True Positive	11224	16474
True Negative	65855	114606
False Positive	10987	32567
False Negative	1680	1556

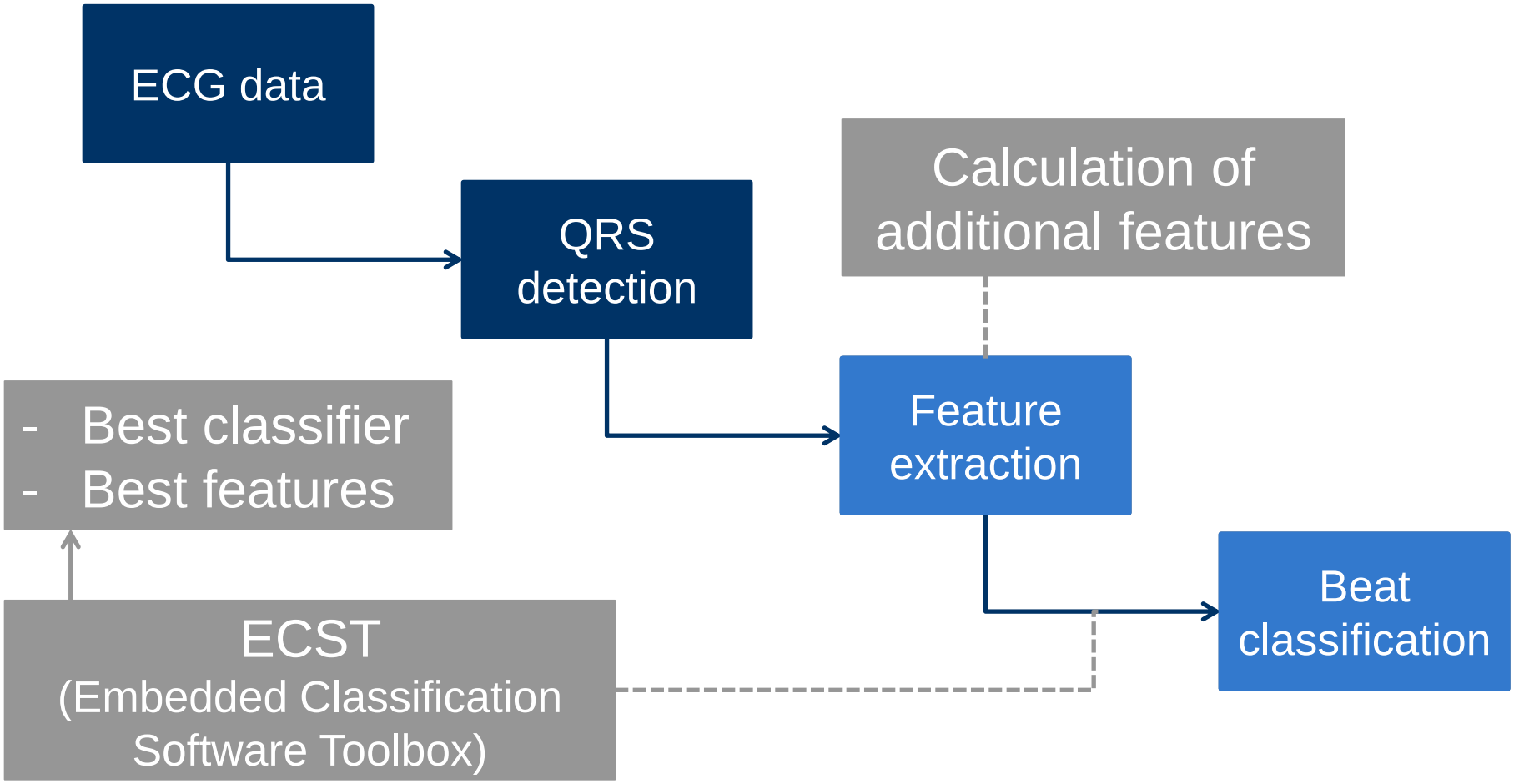
- Sensitivity: 89.5%
- Specificity: 80.6%

(Gradl et al., 2012)

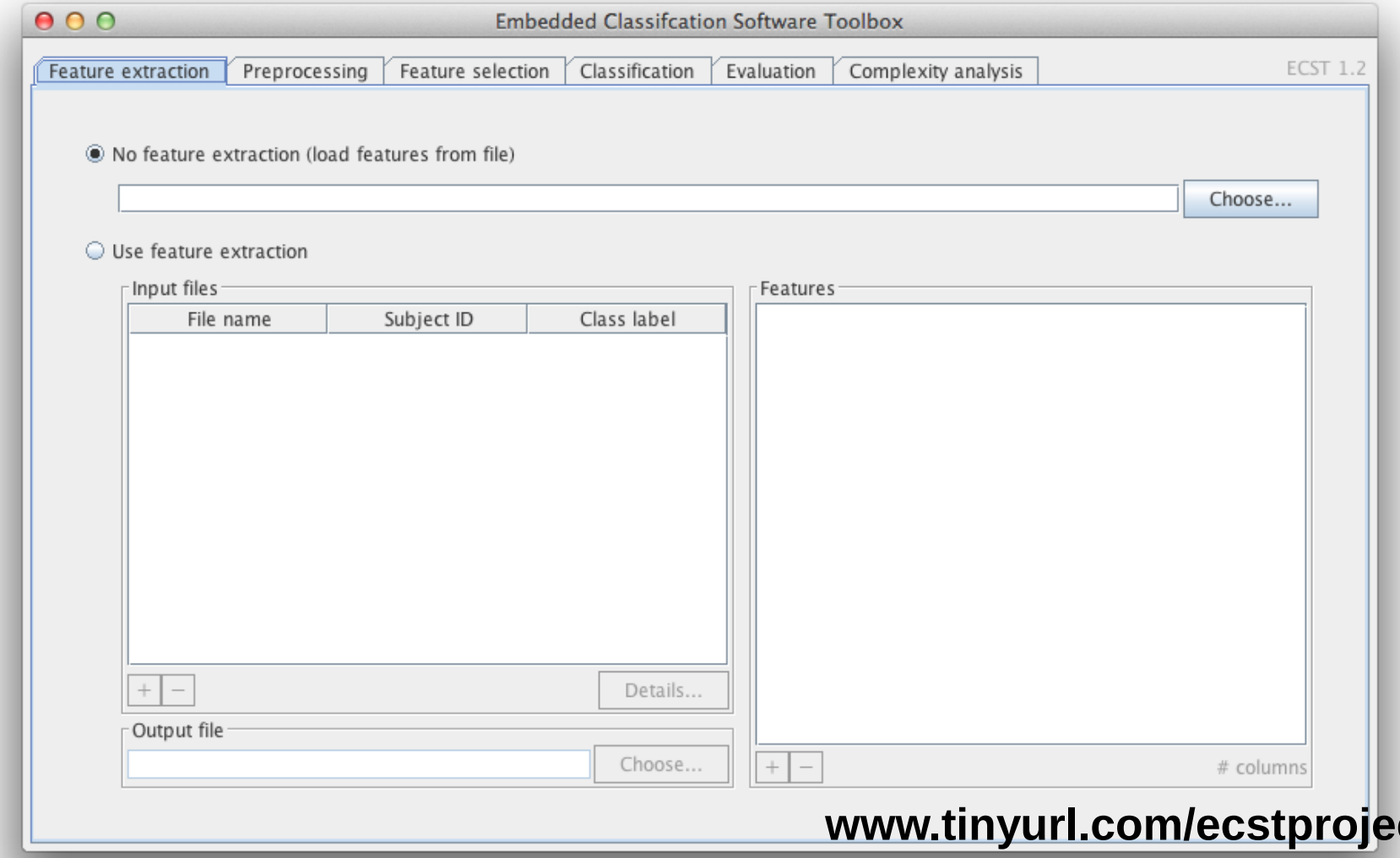
Summary

- Need for mobile, long-term ECG analysis
- Implementation of ECG analysis
- QRS detection in real-time
- Arrhythmia classification
  - Decision Tree Classifier

Outlook – Beat classification



Outlook - ECST



www.tinyurl.com/ecstproject

Thank you for your attention!

ASTRUM IT

Bavarian Ministry of
Economic Affairs,
Infrastructure, Transport and
Technology

adidas

Universitätsklinikum
Erlangen

FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG
TECHNISCHE FAKULTÄT