Real-Time Monitoring of Physiological Signals on an Android Device

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Background

• Current monitoring systems are not flexible and efficient for continuous real-time monitoring of multi-parameter patient data
• Monitoring algorithms are often not patient-specific and use pre-defined thresholds for physiological signal analysis
• Development of mobile medical-monitoring systems involves a trade-off between: size, cost, performance, and power consumption

Goals

• Develop an Android Application for real time analysis of Electrocardiogram Signals (ECG), Blood Pressure, and Heart Rate signals
• Implement algorithms for patient-specific biosignal analysis - features are extracted from the physiological signals during a preliminary training phase
• Analyze performance (execution time) and energy consumption (battery usage) of developed algorithms on the Android device

Progress

• Pre-collected patient data from cardiac ICUs is loaded into the Android application
• Blood Pressure and Heart Rate at the rate of 1 Hz and ECG at the rate of 125 Hz
• Features extracted from each 20-second window

Electrocardiogram (ECG) Feature Extraction

- Mean R-R Interval
- Heart Rate
- Mean Area of Beats
- ADB Variance
- Maximum Mean ADB of 5 Beats
- Kurtosis
- Mean ADB of 5 Beats with Minimum R-R Intervals

Results

<table>
<thead>
<tr>
<th>100 Windows</th>
<th>Time Elapsed</th>
<th>LCD Consumption</th>
<th>CPU Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run 1</td>
<td>2:30</td>
<td>4.3 J</td>
<td>71.6 J</td>
</tr>
<tr>
<td>Run 2</td>
<td>2:45</td>
<td>3.2 J</td>
<td>72.2 J</td>
</tr>
<tr>
<td>Run 3</td>
<td>2:20</td>
<td>4.8 J</td>
<td>67.7 J</td>
</tr>
<tr>
<td>Run 4</td>
<td>2:50</td>
<td>8.5 J</td>
<td>68.6 J</td>
</tr>
</tbody>
</table>

Acknowledgements

Mentor Homa Alemzadeh – Assisted with development of Android application

Jingrui Zhang – Developed initial implementations of the Android application for analysis and display of physiological signals on a mobile platform

Skills Acquired

• Programming in MatLab and JAVA
• Developing and testing mobile applications on the Android emulator
• Measuring the performance and power consumption of Android applications on the emulator
• Gained basic knowledge of biomedical signal processing techniques