Wireless Heart Rate Monitor

HEART ALERT
On-Person Unit
MC13213 (HCS08)

- 16 MHz Bus Frequency
- On Chip Resources
  - 60K of Flash
  - 4K of RAM
- Require Resources
  - 15K of Flash
  - 2K of RAM
- Timeslice Kernel
  - Period: 50 ms
On-Person Unit Tasks

- Start Task
- Waitforslice Task
- Timer Task
- Sampling Task
- Rate Analysis Task
- Alert Task
- Sleep Task
## On-Person Unit Module List

<table>
<thead>
<tr>
<th>Module</th>
<th>Tasks</th>
<th>Public Functions and Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main1.c</td>
<td>StartTask</td>
<td>TimeStamp</td>
</tr>
<tr>
<td></td>
<td>Waitforslice</td>
<td>AlertFlag</td>
</tr>
<tr>
<td></td>
<td>TimerTask</td>
<td>Heart Rate Data</td>
</tr>
<tr>
<td></td>
<td>SamplingTask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RateAnalysisTask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AlertTask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TimerTask</td>
<td></td>
</tr>
<tr>
<td>Start08.c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timer.c</td>
<td></td>
<td>CurrentCount()</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ResetCount()</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Count</td>
</tr>
<tr>
<td>OCDelay.c</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>mc13213.c</td>
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<tr>
<td>Several other freescale provided modules necessary for SMAC</td>
<td></td>
<td></td>
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On-Person Unit
Start Task

- System Initialization
  - CPU
  - SMAC
  - ADC

- Period
  - Run Once out of reset

- Max Execution Time
  - ~100 ms
On-Person Unit

Waitforslicelce Task

- Waits for the remainder of the timeslice period to pass before exiting to the next task
- Period
  - 50 ms (periodic)
On-Person Unit Timer Task

- A timer used to deduce the period of the heart beat and thus how many beats per minute
  - Accuracy: ±50 ms
- Period
  - 50 ms (periodic)
- Max Execution Time
  - 0.5 ms
On-Person Unit Sampling Task

- Turns on LED, Optical Sensor, Instrumentation Amplifier and takes 100 ADC samples
- Period
  - 50 ms (periodic)
- Max Execution Time
  - 8 ms
  - 3 ms (typical)
On-Person Unit
Rate Analysis Task

- Analyze the heart rate data by
  - Averaging the 100 ADC Samples
  - Deciding if period has occurred
  - Obtaining time elapsed since previous peak
  - Calculating Heart Rate in beats per minute
  - Comparing to acceptable range
  - Setting Alert Flag

- Period
  - 50 ms

- Max Execution Time
  - 5 ms
On-Person Unit Alert Task

- Will send the alert signal to the computer connected unit
- Period
  - Once until disarmed (sporadic)
- Max Execution Time
  - 1 ms
On-Person Unit Sleep Task

- Put the CPU into low power mode called Wait
  - Internal Timer Module use as software interrupt to wake the CPU
- Period
  - 50 ms (periodic)
- Max Execution Time
  - 25 ms
## On-Person Unit

### CPU Load

<table>
<thead>
<tr>
<th>Task</th>
<th>Execution Time</th>
<th>Task Period</th>
<th>CPU Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer Task</td>
<td>0.5 ms</td>
<td>50 ms</td>
<td>1%</td>
</tr>
<tr>
<td>Sampling Task</td>
<td>8 ms</td>
<td>50 ms</td>
<td>16%</td>
</tr>
<tr>
<td>Rate Analysis Task</td>
<td>5 ms</td>
<td>50 ms</td>
<td>10%</td>
</tr>
<tr>
<td>Alert Task</td>
<td>1 ms</td>
<td>50 ms</td>
<td>2%</td>
</tr>
<tr>
<td>Sleep Task</td>
<td>25 ms</td>
<td>50 ms</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Total CPU Load</strong></td>
<td><strong>(max)</strong></td>
<td></td>
<td><strong>79%</strong></td>
</tr>
</tbody>
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Computer Connected Unit Tasks

- Start Task
- Waitforslice Task
- User Interface Task
- Alert Pole Task
- Send Alert Task
# Computer Connected Unit Module List

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<td>StartTask, Waitforslice, User InterfaceTask, AlertPoleTask, SendAlertTask</td>
<td>HRLimits, AlertFlag</td>
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<tr>
<td>SCIBIO9s12Dx.a12</td>
<td></td>
<td>sci_open() sci_read() sci_write()</td>
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On-Person Unit
Start Task

- System Initialization
  - CPU
  - SMAC
  - SCI
- Period
  - Run Once out of reset
- Max Execution Time
  - ~100 ms
On-Person Unit

Waitforslice Task

- Waits for the remainder of the timeslice period to pass before exiting to the next task
- Period
  - 15 ms (periodic)
Computer Connected Unit
User Interface Task

- Handles the acquisition of heart rate limits from the user
- Period
  - 15 ms (periodic)
- Max Execution Time
  - 3 ms
Computer Connected Unit Alert Pole Task

- Poles for an alert from the on-person unit and sets an alert flag if an alert is received
- Period
  - 15 ms
- Max Execution Time
  - 1 ms
Computer Connected Unit
Send Alert Task

- Sends an alert to an emergency service
  - For project demonstration, an alert will be displayed on the terminal

- Period
  - 15 ms

- Max Execution time
  - 1 ms
## Computer Connected Unit
### CPU Load

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<td>User Interface Task</td>
<td>3 ms</td>
<td>15 ms</td>
<td>20%</td>
</tr>
<tr>
<td>Alert Pole Task</td>
<td>1 ms</td>
<td>15 ms</td>
<td>6.67%</td>
</tr>
<tr>
<td>Send Task</td>
<td>1 ms</td>
<td>15 ms</td>
<td>6.67%</td>
</tr>
<tr>
<td><strong>Total CPU Load</strong></td>
<td><em>(max)</em></td>
<td></td>
<td><strong>33.34%</strong></td>
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