

Data Acquisition Prototype: Project & System Requirements

Phoenix Ambulatory Blood Pressure Monitoring System

27 July 2008

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Agenda

- Project Vision
- System Vision & Scope (Business Requirements)
- User Requirements
 - Use Cases
 - Business Rules (Algorithms)
- System Requirements
 - Functional Requirements
 - Major Nonfunctional Requirements
- Requirements Work Outstanding

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Project Vision

- Acquire community knowledge about
 - Data acquisition devices
 - Hardware and software co-design
 - Partitioning systems into subsystems
 - Allocating system requirements to subsystems
 - Embedded software architecture options
(round robin, round robin w/ interrupts, ..., RTOS)
 - Hardware options
(MP, memory, gates, buses, ports, clocks, ...)
 - Acquiring hardware components
 - Testing embedded software
- Document results so they can be reproduced

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Project Vision

- Architecture — basic technology
 - Hardware architecture
 - Hardware component selection
 - Embedded software architecture
 - Software language selection
 - Cross-platform development tools
- Prototype
 - Learning is primary
 - Willing to abandon device based on lessons learned
- Acquired data may be simulated

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System Vision

- Data acquisition device *(next slides)*
- Embedded analytics *(next slides)*
- Embedded data storage *(next slides)*
- Device allows ambulation during use
 - At least carriable
- Electrically self-contained
 - Does not rely on external power source

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System Vision

- Data acquisition device
 - Collects continuous analog signals from two sensors
 - At least one is piezoelectric film sensor
 - Measurement Specialties SDT1-028K
 - Collects up to 40 samples per second from piezoelectric film sensor
 - Collects discrete signals from wearer-pressable push-button
 - Converts analog signals to digital signals
 - Turns on and off a human-perceivable device-mounted light

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System Vision

- Embedded analytics
 - Identifies / marks peak of each continuous waveform
 - Voltage
 - Identifies / marks trough of each continuous waveform
 - Voltage
 - Calculates biometrics
 - Heart rate
 - Beats per minute
 - Systolic blood pressure
 - mmHg
 - Diastolic blood pressure
 - mmHg
 - Performs calculations over 5 cardiac cycles every 30 minutes

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System Vision

- Embedded data storage
 - Timestamps each acquired & calculated value
 - Preserves three days of acquired & calculated data
 - Preserves all acquired values
 - See “Data acquisition device”
 - Preserves all calculated values
 - See “Embedded analytics”

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System Vision

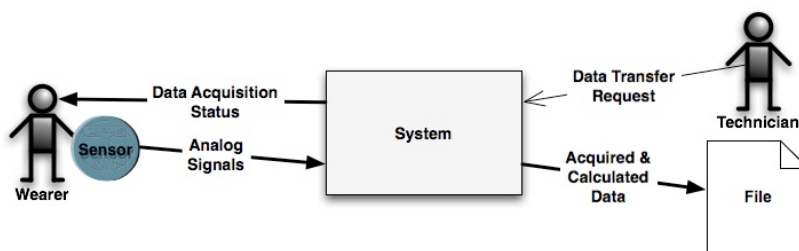
Major Out-of-Scope Capabilities

- Capacity for 7 days of data
- Device calibration
- Patient alerts
- Localization outside of U.S.
 - Production
 - Use
- Analog signal processing
 - As alternative to digital signal processing
 - Separate research topic

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System Context



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Use Cases

- Technician connects device to Wearer
- Wearer starts data collection
- Wearer confirms device is working
- Wearer signals the device to log an event
 - Assures data-acquisition logic despite sensor failure
- Technician downloads data to a file

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Business Rules Algorithms

- Waveform peak
- Waveform trough
- Heart rate
- Systolic blood pressure
- Diastolic blood pressure

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Functional Requirements

- Downloaded Data
 - ::=
 - Head
 - Device ID
 - (Absolute base time)
 - Timestamp of download initiation
 - Body
 - { Acquired/calculated Item }*
 - » Sensor ID/Data Source ID
 - » Timestamp of acquisition/calculation
 - » Information type
 - » Value
 - Tail
 - Timestamp of download completion
 - End of data marker
 - If timestamps are relative
 - then download must include absolute base time

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Functional Requirements

- | | |
|--|--|
| <ul style="list-style-type: none"> • Acquired/calculated information type <ul style="list-style-type: none"> – Acquisition control event <ul style="list-style-type: none"> • Start device • Stop device • Start acquisition • Stop acquisition – Wearer event – Acquired continuous value <ul style="list-style-type: none"> • mV | <ul style="list-style-type: none"> • Acquired/calculated information type <ul style="list-style-type: none"> – Calculated values <ul style="list-style-type: none"> • Heart rate <ul style="list-style-type: none"> – Beats per minute • Systolic blood pressure <ul style="list-style-type: none"> – mmHg • Diastolic blood pressure <ul style="list-style-type: none"> – mmHg |
|--|--|

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Major Nonfunctional Requirements

- Interfaces
 - Outgoing
 - Downloaded data is well-formed XML
 - Physical Connectors
 - Device downloads data via a USB device
- Physical Constraints
 - Wearer wears or carries device during operation
- Legal Requirements
 - *All software to be publicly licensed*

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