

Digital Signal Processing

Breathing Rate Detection System Design

Today's Agenda

- Breathing rate system design
- Need your ideas on how to design the system
- Review the requirements and brainstorm a block diagram
 - We'll use google jamboard
 - <https://jamboard.google.com/>
 - Link is in myCourses

System Design Process

- Define system requirements
 - Might come from customers (internal or external)
- Consider the technologies we have available
 - What have we done so far this semester?
 - What are the constraints and limitations

System Design Process

- Start with a High Level View then drill down
- Brainstorm! Throw out ideas!
- Jot your ideas on the jamboard!

System Description

- Build a breathing rate monitor to warn of a potential acute respiratory problem (pneumonia) in a child age 11 months to 5 years.
- In children, a breathing rate of greater than 50 breaths per minute can indicate pneumonia.
- Fewer than 12 breaths per minute can also indicate an abnormal condition

System Requirements

- Monitor shall detect if the breathing rate is greater than 40 breaths per minute
- Monitor shall detect a breathing rate below 12 breaths per minute
 - May indicate that the sensor is disconnected, or other abnormal condition is occurring
- Either condition shall be detected and alert the caregiver within 2 minutes of its occurrence

System Requirements

- A warning shall be sounded for a breathing rate greater than 40 breaths per minute
- A warning shall be sounded for a breathing rate less than 12 breaths per minute
- The warning for low breathing rate shall be different from that of the warning for high breathing rate

How Do We Design this System

- Consider what you have been working on this semester
- Understanding of signal statistics
- Using dithering, oversample and averaging to improve ADC resolution

How Do We Design this System?

- Using filtering to remove noise
- Using filtering to separate the frequency content of signals
- Computing statistics efficiently in computing systems

More Detailed Things to Consider

- What number systems should I use and why?
 - Integers
 - Longs
 - Floating point
- What types of filters should I use and where?
 - FIR
 - Recursive filters
 - LPF, HPF, BPF, BSF

What are some of my design constraints?

- Program memory limitations
- Data memory limitations
- Processor execution times

- What drives these factors?

- What are my tradeoffs?
 - Execution speed / Data precision
 - Memory usage / Data precision

Let's work on a block diagram

- Start with a high level and then add more detail to each block
- What functions should be included at the highest level?
 - Open up your microphones
 - Video encouraged
 - Build on ideas, make suggestions, feel free to jot down on the jamboard

High Level System Block Diagram
