Multisensory Pre-Alarm System for Physicians

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Mystery Machine

Oral Report 1
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What’s the Problem?

Problem Statement

- Too many distracting alarms and sounds in Intensive Care Units
- Only 23% of ICU alarms go off correctly
- Leads to patient and physician fatigue
  - Snoozing alarms
  - Patient distress
- No differentiation between different parameters

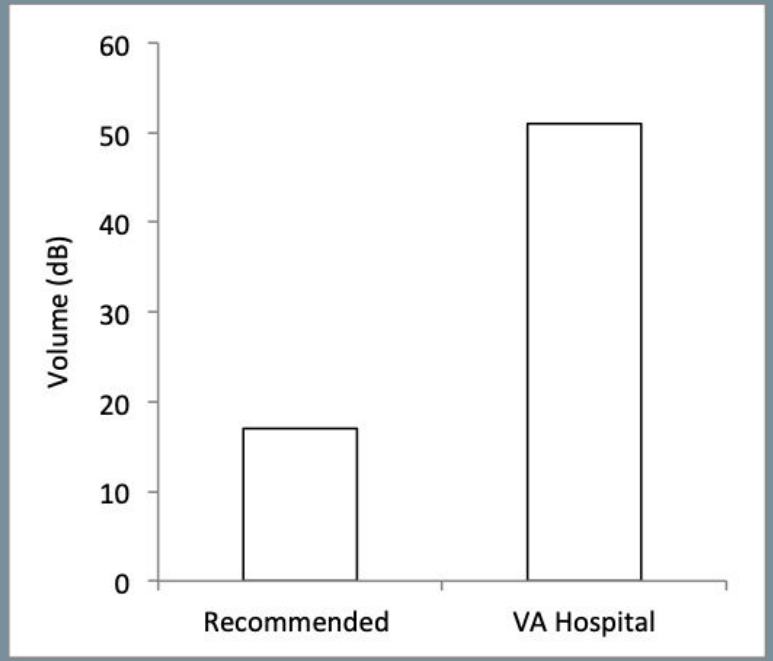
Problem Statement

- Multisensory pre-alarm device
- Alerts physicians before alarm goes off
  - Uses musical sounds and haptics
- Improves positive predictive value
- Less stress for patient and physician

Previous Work

Literature Confirms the Issues

- WHO recommends below 15-20 dB in a clinical environment
- Vanderbilt VA Hospital: 51 dB (1)
- False alarm rates: 72-99% (2)
- Alarm fatigue: #1 technology device hazard in 2013
  - Alarm fatigue → clinician error → adverse patient outcomes
- 500 deaths over 4 years due to faulty alarm management (2)



Dynamic Alarm Systems for Hospitals (D.A.S.H.)

- Self-regulates volume based on environment noise level
- Aims to improve patient safety and ease clinician alarm fatigue
  - Improve sleep, reduce delirium, prevent long-term cognitive impairment
- Testing confirmed that the system successfully regulates volume based on background (2)

Table 1. Sound Measurements From Device and Conventional Alarms in a Patient-Occupied ICU Room

Variable	Minimum Sound Level (dB)	Maximum Sound Level (dB)
Quiet ICU room	44.9	52.3
D.A.S.H. (our alarm)	52	61.5
Infusion pump	62	63
Patient monitor alarm	65	75
Ventilator	70	74

Note. ICU = intensive care unit; D.A.S.H. = Dynamic Alarm Systems for Hospitals.

Multimodal Alarms

- Multisensory integration of the haptic and auditory channels
- Improves information transfer
- Reduced auditory threshold of perception
- Cocktail party example

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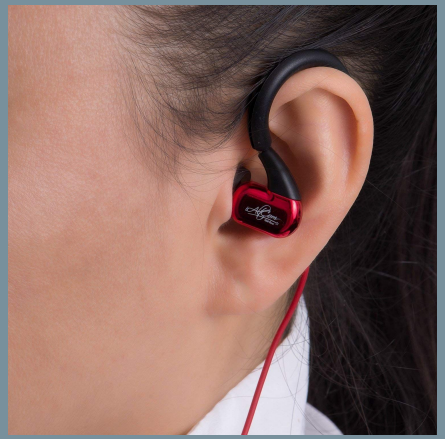


What is needed?

Needs Assessment

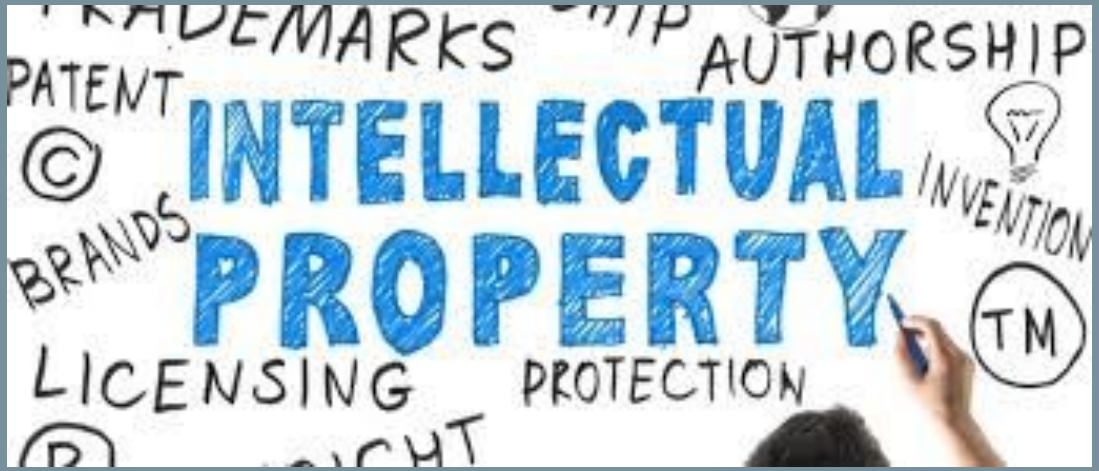
- UX
- Patient Efficacy
- Safety
- Hospital System Efficiency
- Technical Needs

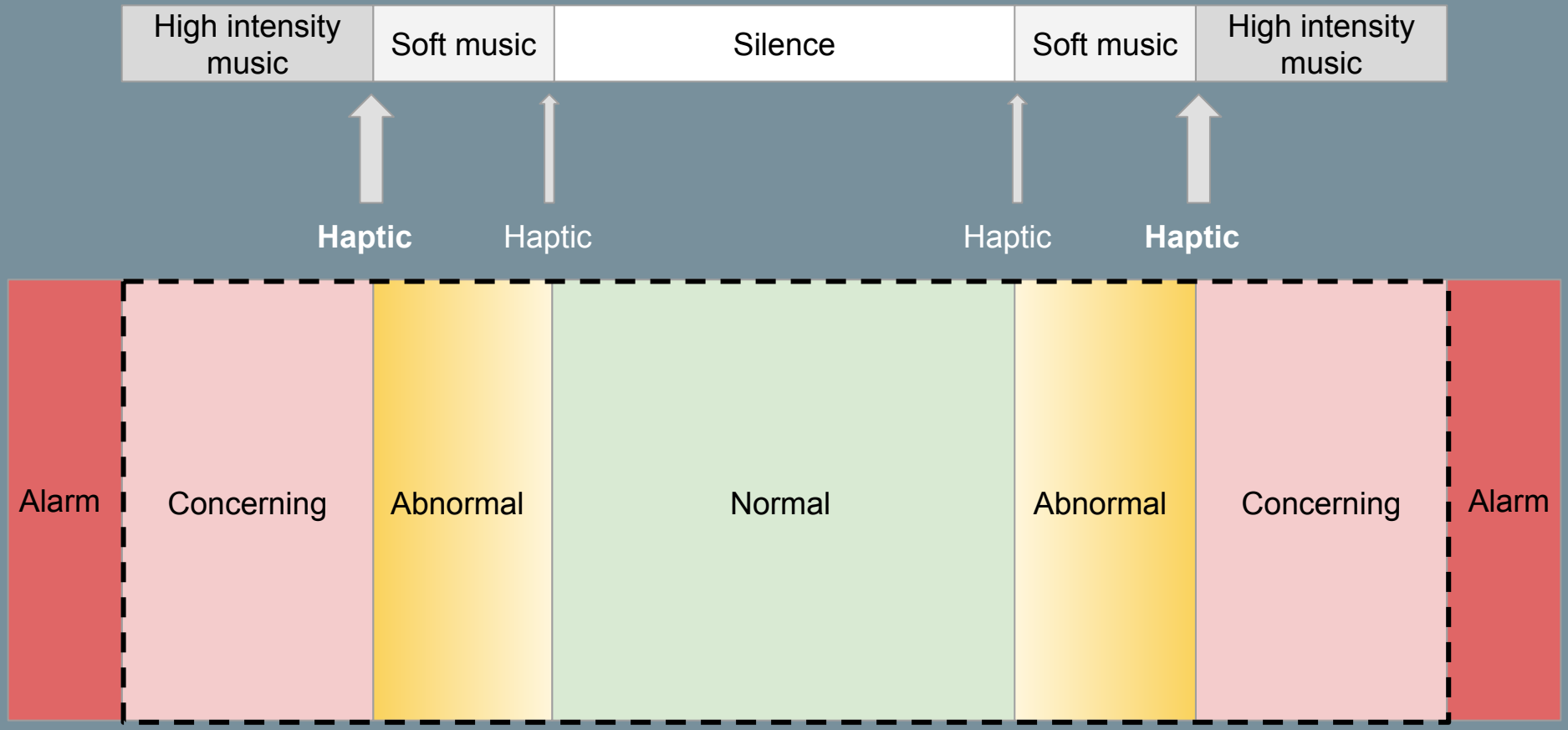
Updates

1) IP Issues
2) Thresholds
3) Sounds
4) Efficacy Tests

IP Issues

- McGill University
- Haptics
  - Next steps



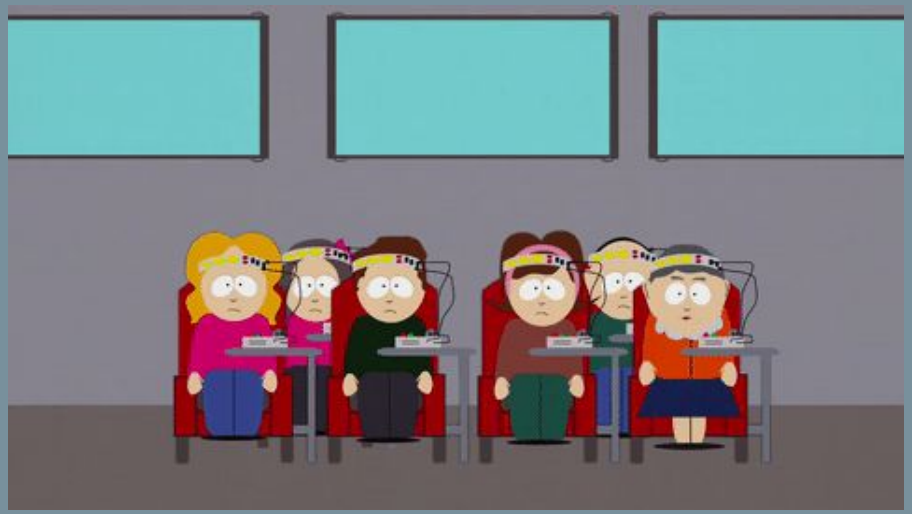


*Additional haptic when change in secondary patient's vitals

Sounds

Next Steps - Short Term

- Determine haptic actuator use
- Create a second iteration of sounds
- Determine different ways to differentiate between the ranges
- Come up with an idea for an experiment



Efficacy Study Planning

- Draft IRB
- Sound recognition and differentiation testing
  - “Black box room”
  - Previous group set up ICU in a dorm room
- Transmitter location efficacy testing
  - Assess ideal haptuator locations
- Power law prediction of study participants
  - Initial expectation of N = 30 based on prior research

Long-Term Planning

- Multiple meetings with Joe to discuss project ideation
  - DIVE Team Collaboration - Python script and improved workflow
  - VA Hospital ICU Visits
- IRB Draft and Efficacy Studies
- HFES Conference March 2019 - Chicago
  - Meet with Dr. Schlesinger's collaborators from multiple institutions
  - Increase insight into other research in the field
- Beyond design day
  - Plans to publish?

References?

1. Alirezaee, P., Girgis, R., Kim, T., Schlesinger, J. J. and Cooperstock, J. R. (2017). Did you feel that? Developing novel multimodal alarms for high consequence clinical environments. *ICAD*.
2. Burdick, K. J., Chowdhury, A. R., Greer, J. M., and Schlesinger J. J. (2018). Dynamic Alarm Systems for Hospitals (D.A.S.H.). *Ergonomics in Design*.

QUESTIONS?