Multisensory Pre-Alarm System for Physicians

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Mystery Machine

Oral Report 7
March 28, 2019

Problem Statement

- Distracting alarms and sounds in Intensive Care Units
- Leads to patient and physician fatigue
- No differentiation between different parameters

Needs Assessment

- UX

- Patient Efficacy

- Safety

- Hospital System Efficiency

- Technical Needs

Needs Assessment

- UX

- P

- S

- H

- T

Updates

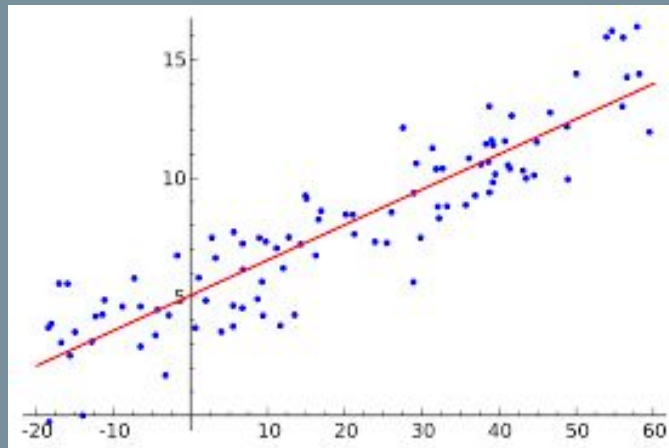1) Data Analysis Plan
2) Reflections on Studies
3) Conference

Data Analysis Plan

Current Data

Subject	Overall			Change			Vital			Zone			Time		
	None	Cont	Disc	None	Cont	Disc	None	Cont	Disc	None	Cont	Disc	None	Cont	Disc
1	14.333	14.5	6.8333	14	13.5	11.5	11	11.5	7.5	11	9.5	9.5	5.455	7.30078	6.39762
2															
3	20.833	14.333	14.5	15.5	13.5	13.5	14.5	11.5	11.5	14.5	8.5	10.5	6.14125	7.65565	8.62167
4	20	16.333	25.5	16	14	17	15	14	17	11	9	17	6.9941	6.27861	5.9586
5	13.667	16.667	19	14	14	15	11	13	14	12	9	15	5.88692	6.5155	5.2646
6	0.1667	1.8333	-6.6667	8	8.5	7	5	5.5	1	0	1.5	2	5.5201	5.66772	5.65192
7	20.5	22.833	17.5	16	15.5	14.5	15	15.5	13.5	12	14.5	10.5	4.83178	6.18181	6.90581
8	13.167	20.167	23.333	12	14.5	15.5	10	13.5	15.5	9	13.5	15.5	5.2909	6.00664	5.57499
9	25.5	13.833	22.833	17	12.5	15.5	17	10.5	15.5	17	10.5	14.5	5.29621	5.06525	6.27506
10	6	-9.3333	-2.8333	13.5	7.5	13	8.5	-1.5	4	8.5	-1.5	5	7.33046	5.49817	6.19216
11	25.5	23.333	23.333	17	15.5	15.5	17	15.5	15.5	17	15.5	15.5	5.41533	5.84332	5.66244
12	20.167	18.667	3.5	17	14	10	15	13	6	15	14	4	5.65595	5.3947	6.77753
13	22.333	24.833	25	17	16.5	17	16	16.5	17	17	16.5	16	5.06469	5.4736	4.99748
14	23.333	15.667	25.5	15.5	14	17	15.5	12	17	15.5	11	17	4.59521	6.90012	5.2186
15	16.833	7	18.167	13.5	9.5	14	12.5	6.5	13	12.5	6.5	13	6.8633	5.46857	6.72469
16															
17															
18	12.833	6.8333	17.167	15.5	13.5	16	13.5	8.5	14	5.5	5.5	11	6.97951	4.93366	6.17391
19	22	0	13.667	15	0	13.5	15	0	10.5	13	0	12.5	7.30213		7.01927
20	18.833	9.8333	4	14	14	10.5	12	10	6.5	11	11	1.5	6.36048	8.11374	7.09445
21	14.5	16.667	25	15.5	13.5	17	12.5	12.5	17	11.5	11.5	16	6.35987	6.88523	6.64939
22	11.667	25.5	25.167	13	17	17	10	17	17	10	17	17	6.139	5.87107	5.1683
23	25.5	24.667	17.167	17	17	14	17	17	13	17	16	10	6.39595	6.48825	7.66383
24	11.833	17.833	17.167	11.5	15.5	13.5	9.5	13.5	12.5	9.5	12.5	12.5	6.79937	6.76543	6.74355
25	14	17.5	10.5	14.5	15	11.5	11.5	13	9.5	13.5	12	7.5	7.57517	5.78077	6.95395
26	21.5	-11.5	7	13.5	6	10	13.5	-2	8	12.5	1	5	5.64593	3.74223	6.12283
27	-6.3333	16.667	14	10	14.5	15	2	13.5	12	1	7.5	10	5.14437	6.77374	6.80639
28	24.833			17			17			17			5.25963		
29	18.333	6.5	23.333	13	11.5	15.5	12	6.5	15.5	11	5.5	15.5	6.82989	5.88675	6.29417
30															
31	21.333	14.833	18.833	16	12	15	16	11	14	12	10	13	5.87406	5.35182	6.19796
32	-2.8333		15.167	11		12	4		10	1		11	5.34414		5.87447
33		22	11.333		16	13.5		16	10.5		14	7.5		6.94559	6.57896
34	14.5	10	24.667	13.5	12.5	16.5	11.5	9.5	16.5	9.5	6.5	15.5	6.6197	5.1358	6.25837
35	19.167	4.1667	17.5	14	10	15.5	14	5	13.5	10	2	13.5	7.14881	6.6211	6.33081

Future Plan

- Linear regression model
- Compare different models

Score = β_1 * sound(1) + β_2 * continuous(0,1) + β_3 * discrete(0,1) + β_4 * sound order(1,2,3) + β_5 * continuous order(1,2,3) + β_6 * discrete order(1,2,3)
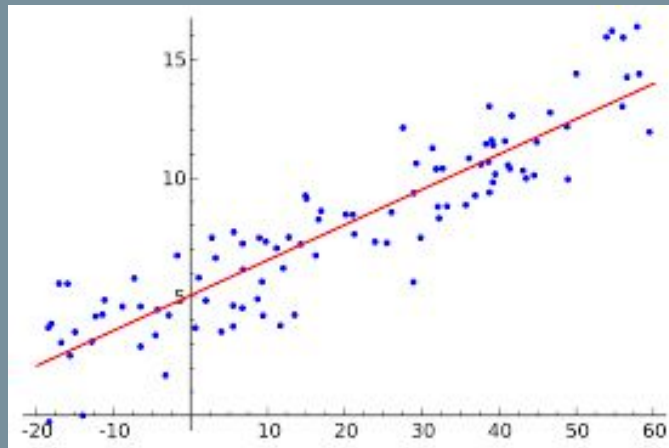
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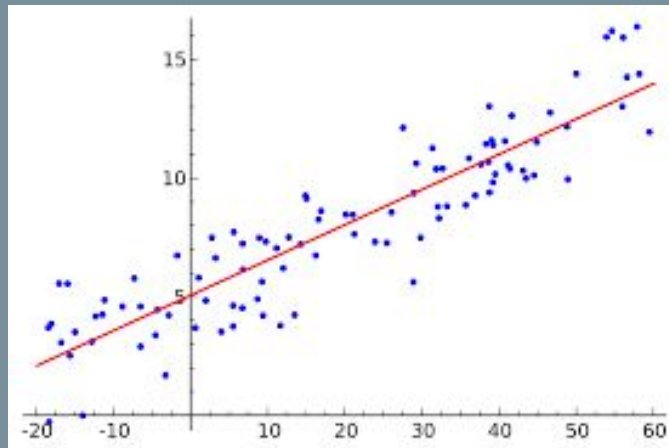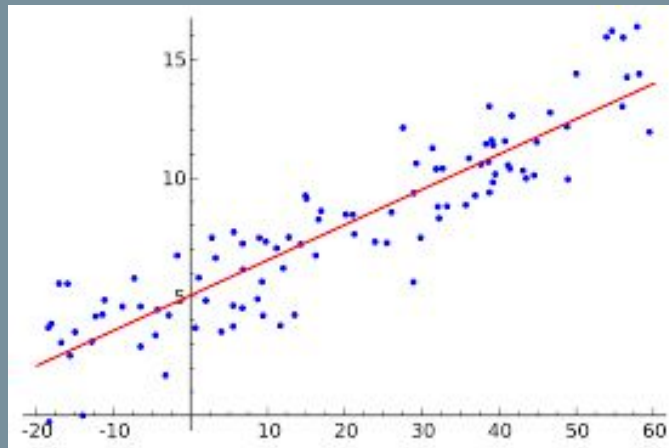- Compare different models

Score $= \beta_1 *$ sound(1) $+ \beta_2 *$ continuous(0,1) $+ \beta_3 *$ discrete(0,1) $+ \beta_4 *$ sound order(1,2,3) $+ \beta_5 *$ continuous order(1,2,3) $+ \beta_6 *$ discrete order(1,2,3)

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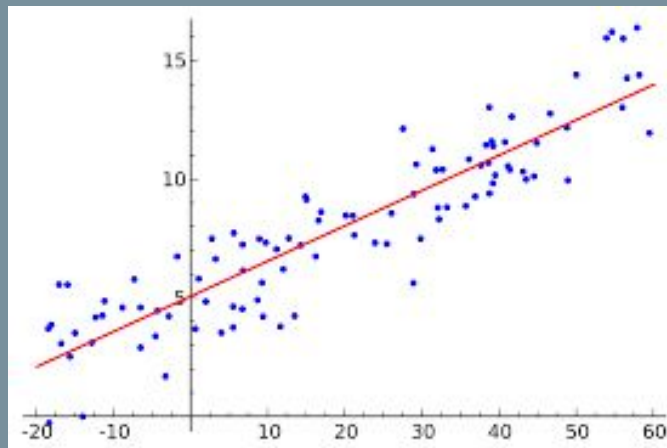- Compare different models

Score = β_1 * sound(1) + β_2 * continuous(0,1) + β_3 * discrete(0,1) + β_4 * sound order(1,2,3) + β_5 * continuous order(1,2,3) + β_6 * discrete order(1,2,3)

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Preliminary Stats Conclusions

- So far it looks like:
    - Haptics has a significant effect
    - Order statistically matters
    - Block variation may have an effect
- Still have much more to look at
- Still need to analyze qualitative data

Reflections on Studies

Issues we Faced

- Took a while to understand last year's MATLAB code
- MATLAB issues during studies
  - IP address changing
  - Order of running computers
- Code could be further optimized to ease process of running studies and minimize issues

Successes

- Figured out how to sync computers
  - Did not need to split audio
  - Play music + two haptuators at same time
- Created sounds that people performed significantly better with
- Tested response time

Play book

- Guide to our code/study
- Overview of successes/issues
- MATLAB tips if running similar study
- Qualitative aspects of study
  - Qualitative results of sounds/haptics
  - Volume and UX
  - Efficiency
- Our thoughts on potential future directions, etc. based on our results

Conference

Conference Reflections - HFES in Healthcare 2019

- Saw Dr. Schlesinger's research three times
  - Haptics usage for healthcare providers
  - Multitasking and distraction studies when responding to simulated patients
  - International symposium session
    - Masking
    - Alarm standards changes (IEC60601-1-8)
- Resilience Engineering
- VR and its use in Product Design
- Skeletomuscular Pain and Ergonomics for Surgeons

Design Day Planning

- Focus on the science
- Emphasis on alarm fatigue and dangers
- Haptic & audio interactive portion
- Visitor can:
  - Put bone conduction headset on
  - Press wrist and ankle to Basslets
  - Listen to/feel pre-alarm, ending in actual alarm
  - Watch an animated graphic of vitals

Place left hand palm-up here

Basslet
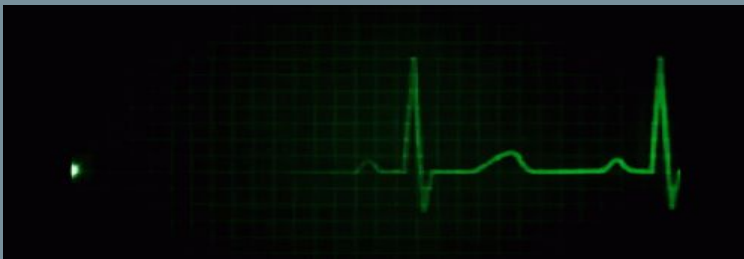
Next Steps/Design Day

- Complete paper (2nd draft)
- Finish up data analysis
- Senior Design action steps
- Code documentation
- "Play Book" for next year's group

Questions?