DETECTION AND ANALYSIS OF SMOKING EVENTS WITH WRIST WORN SENSORS

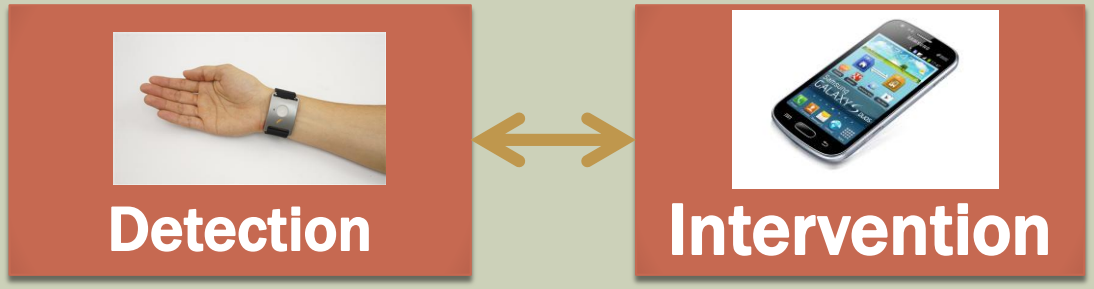
ARTEM DEMENTYEV

Affective Computing

December 3, 2013

MOTIVATION

Big goal - find effective way to help people quit smoking using technology



Accurate detection of smoking event with wrist worn sensors: is there a measurable emotional component, to facilitate detection?

RELATED WORK

	positives (precision) true	false	hit-ratio (recall) hard	fair	perfect
0	56.4%	43.6%	0.0%	14.3%	48.6%
1	61.8%	38.2%	63.6%	50.0%	73.3%
2	69.2%	30.8%	100.%	16.7%	76.2%
3	17.4%	82.6%	30.%	0%	16.7%
	51.2%	48.8%	48.8%	20.2%	53.7%

2012 Sixth International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing

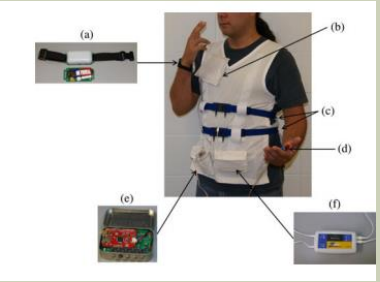
A Feasibility Study of Wrist-Worn Accelerometer Based Detection of Smoking Habits

Philipp M. Scholl and Kristof van Laerhoven
Embedded Sensing Systems, ESS
Technische Universität Darmstadt
Email: scholl,kristof@ess.tu-darmstadt.de

IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 60, NO. 7, JULY 2013 1867

Monitoring of Cigarette Smoking Using Wearable Sensors and Support Vector Machines

Paulo Lopez-Meyer, *Member, IEEE*, Stephen Tiffany, Yogendra Patil, and Edward Sazonov*, *Senior Member, IEEE*



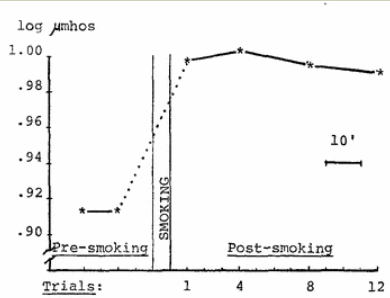


Fig. 9. Skin Conductance: Overall mean effects (raw scores)

Cardiovascular Variables, Skin Conductance and Time Estimation: Changes after the Administration of Small Doses of Nicotine

C. Agué
Medical Research, Sandoz Ltd., Basle, Switzerland

Received July 20, 1973; Final Version March 13, 1974

Hypothesis: Smoking or anticipation of smoking causes arousal

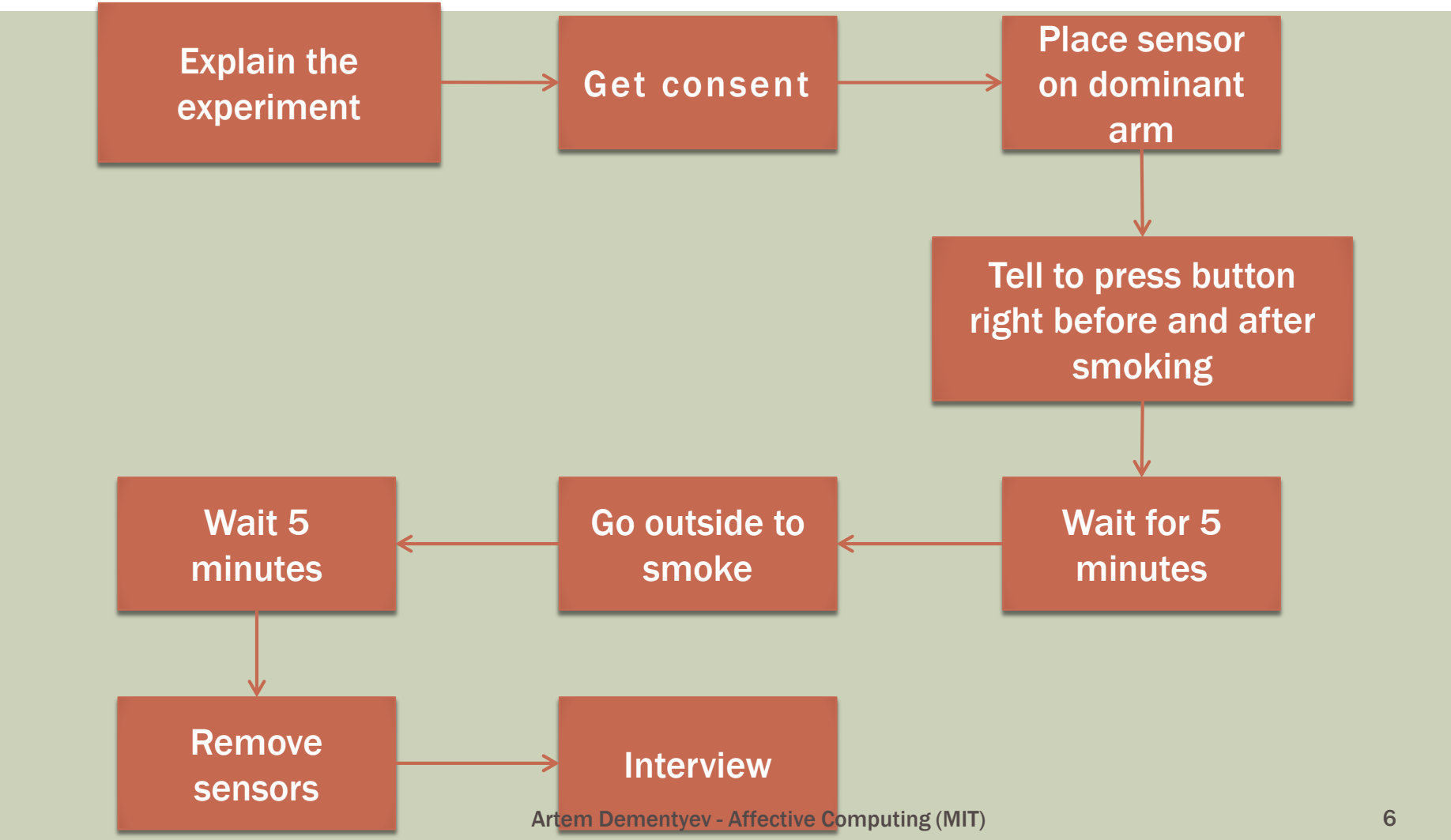
SUBJECTS

- N = 13 (Males: 10, Females: 3)
- Age: 22-44
- 10 everyday smokers, 3 occasional smokers
- 1 was excluded

- 10 subjects were studied at physician's office in Maryland
  - Before or after their doctor's appointment.

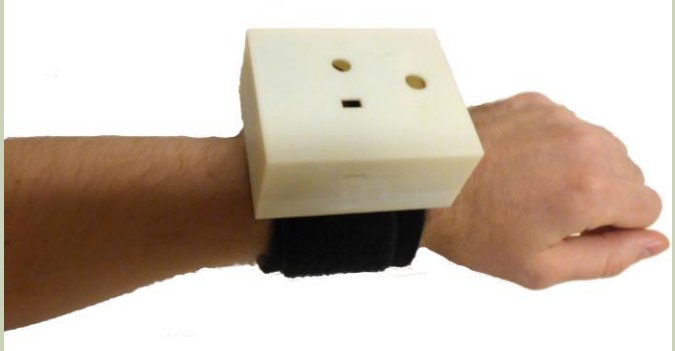
- 3 subjects in Cambridge

EXPERIMENTAL SETUP



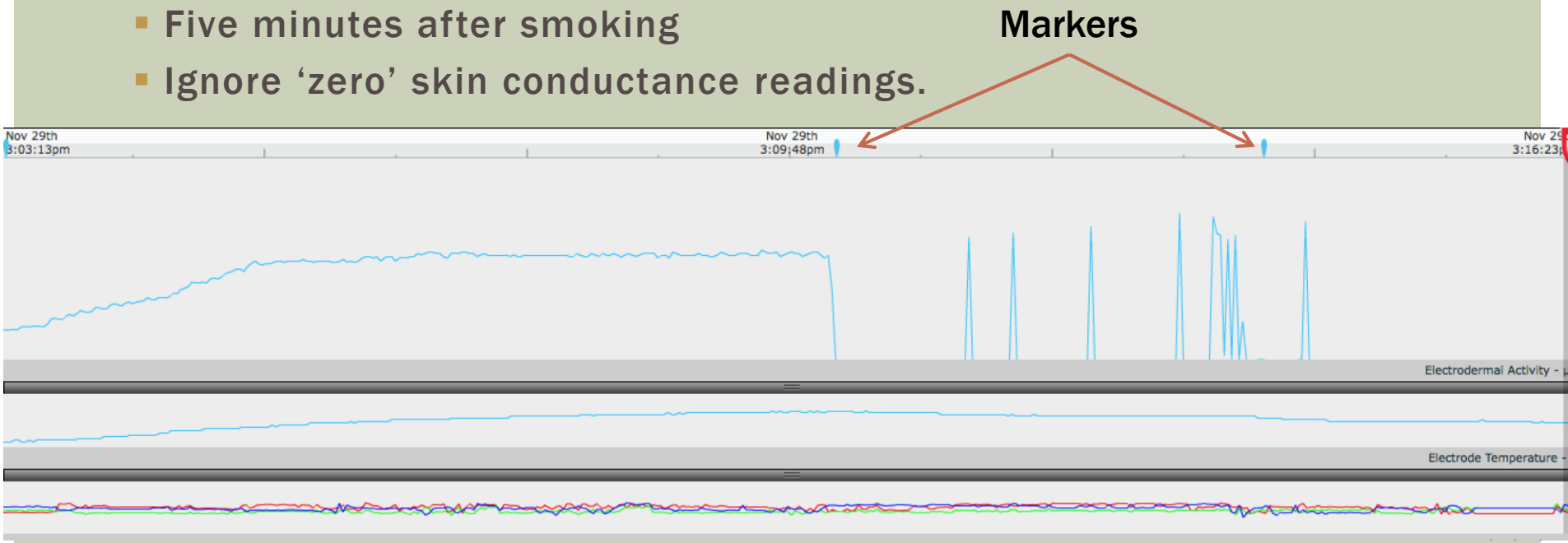
SENSORS

- Q – sensors on the wrist
  - Skin conductance
  - Acceleration
  - Temperature
- Experimented with dust sensors
  - Not used in experiments – too large



EVALUATION

- Mean:
  - Five minutes before smoking
  - During smoking
  - Five minutes after smoking
  - Ignore ‘zero’ skin conductance readings.



Mean: before, during and after smoking

Arousal increased during smoking: 3 subjects

Decreased: 6

About the same: 3

STATISTICAL ANALYSIS

- Two sample T-test
- P value is above 5%: no statistical significance
- P <0.0001 in the previous study (Ague, 1974)

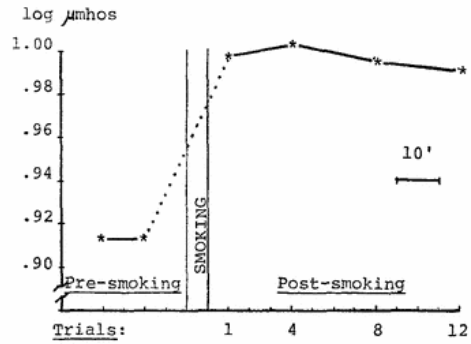
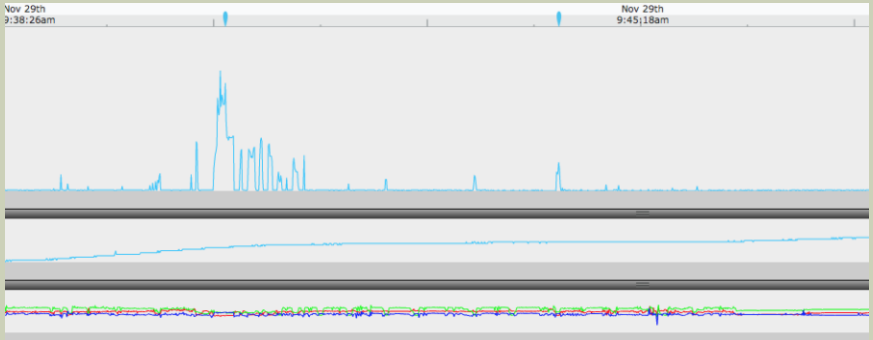


Fig. 9. Skin Conductance: Overall mean effects (raw scores)

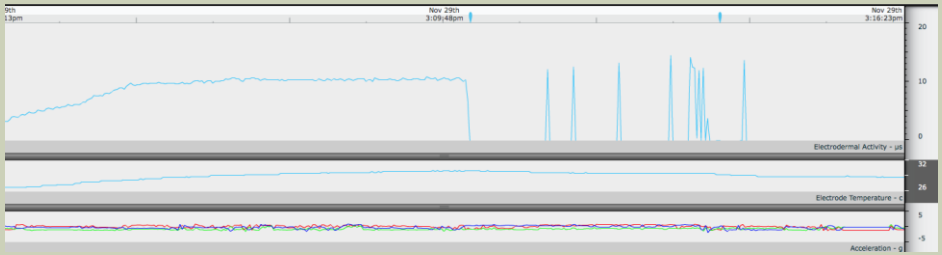
Ague, 1974

REGULAR OR OCCASIONAL SMOKERS

Occasional

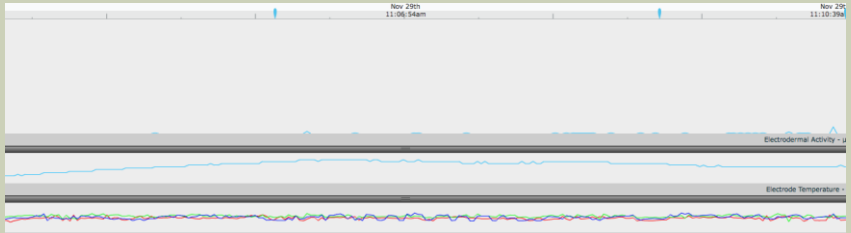


Subject 5



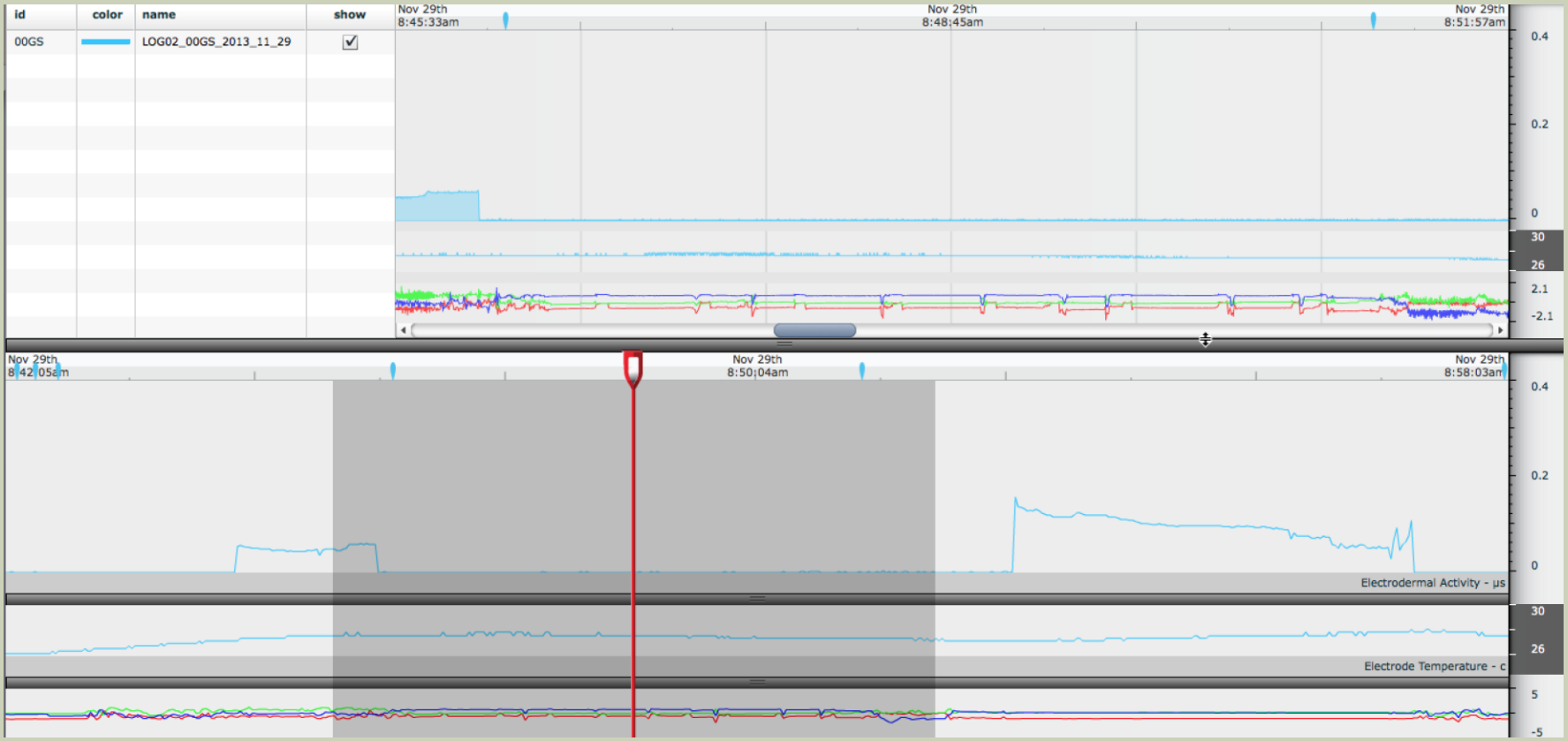
Subject 12

Regular

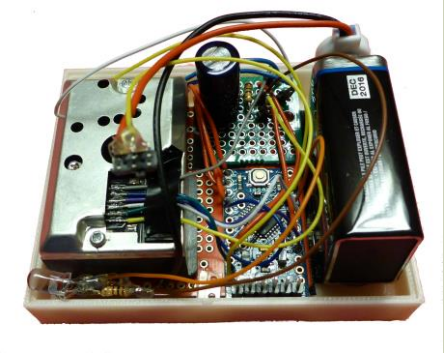


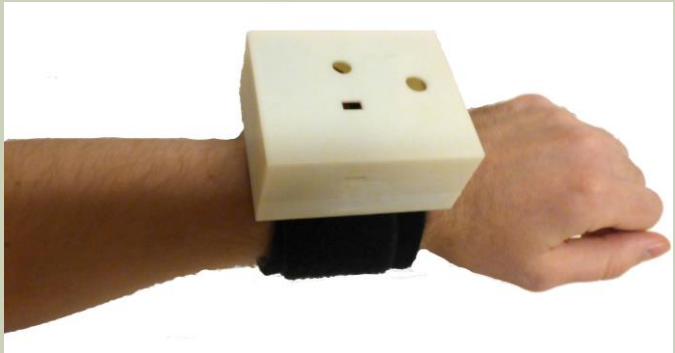
Subject 8

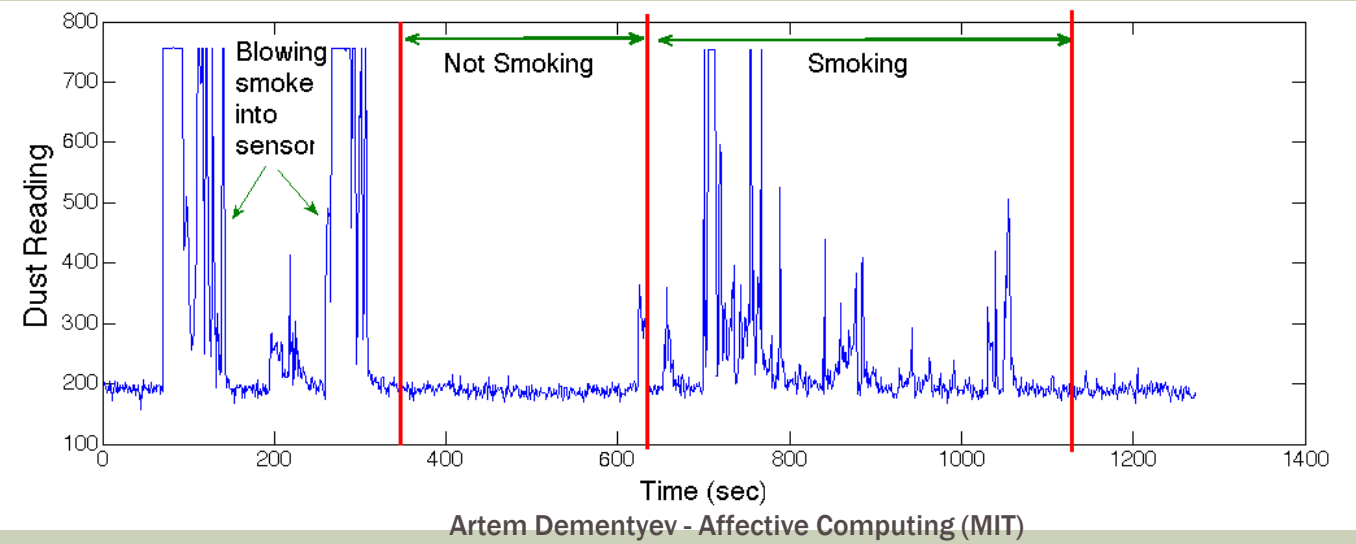
TEMPERATURE AND ACCELERATION



WEARABLE DUST SENSORS







CONCLUSIONS

- **Decrease in arousal is most common, but not statistically significant**
- **No clear trends**: different responses in different people
  - Increased arousal
  - Decreased arousal
  - Same level
- Response is most apparent in occasional smokers

DOES SKIN CONDUCTANCE DETECT SMOKING EVENTS?

- Not by itself, but can provide insights, especially in occasional smokers
- Sensors need to be tailored to the person
- Sensor fusion is needed to detect smoking

LIMITATIONS

- Only one smoking even for each subject.
  - Not sure if responses are reproducible
- Data quality: skin conductance sensors were often out of range
- Experiments are not in laboratory conditions.
- No thorough interviews.

WHAT I LEARNED

- People are generally willing to participate.
  - Only one subject out of 14 declined to participate.
  - Recruited almost 3x more subjects then expected.

- Often subjects forget to follow directions. Need safeguards.

ACKNOWLEDGEMENTS

- Dr. Michael Gendel