Stress@work

What's your current stress level?
Detection of stress patterns from GSR sensor data

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http://www.win.tue.nl/stressatwork
Outline

• What is stress?
• Acute stress detection as drift detection
• Preliminary experimental results
• Further work
Impact of Stress at Work

**WHO:** by 2020 Top 5 diseases will be stress related.

**USA:** health care expenditures are ~50% greater for workers who report high levels of stress at work (J. Occup. Env. Med, 40:843-854).

**the Netherlands:** (TNO, 2006):

- The direct costs of stress are 4 billion Euro per year.
- Every year 150,000 – 300,000 employees become ill because of stress at work.
- 1 out of 7 disabled gets his condition because of stress at work.

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Parties Interested

- Insurance companies
- Employers and employees
- Health and safety executives
- Medical specialists
Types of Stress and Stressors

Three kinds of stress:

• Acute: caused by an acute short-term stress factor.
• Episodic acute: occurs more frequently & periodically.
• Chronic: caused by long-term stress factors - harmful.

Factors causing stress@work:

• long work hours, work overload, time pressure, difficult, demanding or complex tasks, high responsibility, lack of breaks, lack of training
• conflicts, underpromotion, job insecurity, lack of variety, and poor physical work conditions (limited space, temperature and lighting conditions)

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It’s Better to Prevent Than to Cure

• Physical signals of acute stress can be observed:
  – Skin conductivity
  – Heart rate
  – Facial expressions
  – ...

• Philips develops a device measuring and recording vital signs like skin conductivity (GSR) and heart rate, with a high frequency

Be-EEP!
You are getting stressed!
How to measure stress

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How to measure stress

Determine stress level based on observed sweat production

Stress factor

Sympathetic system

Heartrate

Sweat production

Other

Other factors

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Detection and Categorization of Stress

Based on GSR data alone - not as easy as the following figure may suggest:

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Our current detection approach

Online settings

Raw sensor data → Noise Filter (Median filter) → Aggregation (sec → min) → Discretization (SAX) → Change detection

\[ \bar{y} = (y_{t_c} \ldots y_{t_{curr}}) \]
\[ \bar{y}' = f(\bar{y}) \]
\[ \bar{y}'' = g(\bar{y}') \]

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Preprocessing steps

(a) Raw GSR signal
(b) Filtered GSR signal
(c) Aggregated GSR signal
(d) Discrete GSR data
Experiment Setup

Data set summary.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of users</td>
<td>5</td>
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<tr>
<td>Number of time series</td>
<td>72</td>
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<td>Time series per user (mean)</td>
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<tr>
<td>Mean length (samples)</td>
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<tr>
<td>Number of change points overall</td>
<td>368</td>
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<tr>
<td>Mean change points per series</td>
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</tbody>
</table>

• Change detection in online settings
Results

What's your current stress level?
Results

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Challenges in Stress Detection

- All kinds of noise, e.g. loosing contact with the skin

- Activity (exercising), environment (cold/hot) context and personal differences may impact GSR we observe
Interpretation Isn’t Straightforward

No recovery? Rising temperature?

Different GSR levels
Is Acute Stress Good or Bad?

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What is the Relaxation Then?

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11 Dec 2011, HaCDAIS@ICDM'11
Is “Normal” Condition Good or Bad?

What if someone’s patterns looks like
NNNNNNNNNNNNNNNNNNNNN ......
What, When, Where, with Whom

Stress detection and prediction

Vital signs

(non-) work-related content

Coaching

“Reschedule”

“Prepare”

“Take a break”

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Stress Analytics

• Make a person aware of what is happening
  – how they spend their time and when and from where the stress comes in

• Provide valuable input for pattern mining/knowledge discovery
  – Much richer data

• Visual analytics
  – Interactive exploration of stress-related data
  – Collecting subjective data/labels from a person
SentiCorr – come to our demo on Monday

How much positive and negative content do we read or write?

Phirchose

Crawlers, Fetchers & Scrapers
- Twitter
- Hyves
- Facebook
- Outlook

GUI

OLAP

INIT

Indexing
Content & Metadata

Twitter

Hyves

Facebook

Outlook

INSTALL

Language Identifier
- LIGA

POS Tagger
- TreeTag

Subjectivity Detection
- AdaBoost

Polarity Detection
- RBEM

Sentiment Analysis

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OLAP Style Exploration of Data Summaries

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Exploration of Individual Cases, e.g. e-Mails
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Conclusions and Future Work

• The detection of stress/arousal is a challenging task on itself:
  – varieties of noise and patterns in the data

• GSR data alone is highly ambiguous due to hidden contexts.
  – not clear whether certain peaks correspond to a significant physiological process, and
  – how to categorize these peaks further if they do

• Context-aware change detection and categorization; explanation of drifts