



Mad@Work

A foundation for healthier, happier employees

The ITEA project Mad@Work focused on the detection and mitigation of work stress and poor environmental conditions through various tools that turn real-world data into actionable information. This helps to reduce the burden of poor mental health on employees and thereby on businesses and society.

Around 50% of all lost working days relate to work stress, which also results in lower productivity, employee turnover and early retirement. Alongside the burden on individuals, the economy suffers: in advanced economies, up to half of workers are knowledge workers with high expertise that cannot be swiftly replaced. Sensor-based mental health assessment offers a solution but remains a new research area in which approaches and results vary significantly.

Whereas many solutions attempt to tackle stress as it occurs, Mad@Work addresses core issues and facilitates prevention. This requires a mix of assessment means (such as sensors and self-reports) and individual support tools, but also organisational support tools in areas like human resources management and indoor environmental quality (IEQ). Due to the infancy of this field, Mad@Work has primarily been research-oriented; a number of solutions are the first to ever use real-world data rather than laboratory data. To this end, they collected data from seven pilots focused on knowledge workers and the workplace environment, the results of which are being exploited in a wide variety of ways.

Technology applied

Mad@Work's stress detection, utilising video-based and computer usage monitoring, had not previously been achieved with real-life long-term data. The real-time video-based stress detection methods utilise heart rate variability monitoring and/or facial expression monitoring. Computer usage

data concerns mouse movements collected without knowledge of user tasks, applications or webpages. In addition, wearables can be used to obtain heart rate, body temperature and physical activity data. Mad@Work also developed tools to visualise obtained stress and stressors data and to use these data to trigger actions. Individual support tools visualise monitoring results as dashboards and provide recommendations on coping with

of wellbeing for which human action (e.g. further investigation) is needed. For environmental comfort, Mad@Work's key innovations include a semantic model or digital twin of room occupancy, coupled with machine learning to measure indoor air quality, and a predictive model to forecast how soon air quality will degrade as air quality affects productivity and health. As these and the stress detection solutions are all deployed separately, Mad@Work proposes the use of privacy labels to present companies with clear information on how combining products impacts privacy and to inform employees of how their data will be used. The solutions are presented separately to the company and



Organisational tools visualise conditions of teams and offices, individual support tools visualise conditions of individuals and provide recommendations on coping with immediate and prolonged stress.

immediate and prolonged stress. Users can give feedback on recommendations and thereby tailor them to their needs. Furthermore, the project has developed a novel Organisational Barometer concept and prototype that leverages self-reporting and sensing data to enable awareness among both employees and employers and to highlight the aspects

its employees; companies must assess that employee anonymity can be ensured and employees can choose which tool to use, if any.

Making the difference

Mad@Work achieved great success in developing unobtrusive stress detection methods for long-term real-life use:

the algorithms to detect stress using real-life video data have reached 83-87% accuracy with daily, hourly and five-minute granularity, the algorithms to detect stress using wearable watch achieved an accuracy of 84.9% per hour, while the algorithms to detect stress and stressors using real-life mouse data achieved an accuracy of 72% per day or 80-84% per quartile. Similarly, novel methods to assess room occupancy and make air quality predictions have achieved over 80% accuracy. Given the project's primarily research-based nature, these are positive results that will continue to be developed, such as in five ongoing PhDs. Another novelty is the use of stress detection results in individual and organisational support tools; such tools currently only use questionnaires.

For the partners, the benefits of Mad@Work take a variety of forms. This includes boosting existing business cases, such as Helvar's decision to significantly invest in a new sensing platform based on the project's IEQ research; this will be integrated with their existing lighting control systems. New business segments have also been opened up: Glintt's and Ageas commercialisation, for instance,

introduces them to the new market of AI for mental healthcare prevention. Hinsta has used sensor data integration and organisational overview tools, developed in Mad@Work, to improve client progress monitoring and the monitoring of Hintsä's results. The Korean partners are also using their organisational tools internally to improve wellbeing and promote broader uptake of the tools.

Although Mad@Work targeted workplace stress and environmental conditions, the technology will also have an impact beyond this. HI-Iberia, for example, aims to exploit their results at the individual level for sleeping disorders – traditionally done solely with wearables – while Granlund intends to develop an AI-powered scalable learning facility using Mad@Work's breakthroughs on IEQ analytics and space utilisation. This will boost their own sustainability and that of their clients via greater energy efficiency. The consortium plans to exploit some of the results in another project on AI for enterprise resilience, but for now Mad@Work serves as a vital foundation for healthier, happier and more productive employees.

Major project outcomes

Dissemination

- > 43 conference presentations.
- > 22 journal publications (and 20+ in the process).
- > 15 meetings with end users, including HR and trade union representatives.
- > 2 PhD thesis completed; 5 ongoing.
- > 9 Master thesis completed.

Exploitation (so far)

New products:

- > Mental well-being solutions to mitigate chronic and current stress.
 - > For current stress: meditation content based on MBSR (Mindfulness-Based Stress Reduction), breathing and chair stretching content for office workers.
 - > For chronic stress: recommendations for time control, task prioritisation, dealing with perfectionism, finding meaning at work, etc.
- > Update of existing product for human coaching: integration of sensor data analysis results and visualisations of organisational data.
- > Update of existing IEQ products with new sensors, AI-based self-calibration, etc.

New service:

- > Cloud-based maintenance platforms for air purifiers.

New system:

- > Systems for monitoring and visualising (1) personal stress and (2) organisational stress, which can use self-reports and sensor data analysis (facial, physiological and behavioural data) and visualise stress, stressors and their history.

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Partners

Austria

- > Beia GmbH

Finland

- > Finnish Institute of Occupational Health
- > Granlund Oy
- > Haltian Oy
- > Helvar Oy Ab
- > Hintsä Performance
- > Nixu Oy
- > UniqAir Oy
- > VTT Technical Research Centre of Finland Ltd

Portugal

- > Glintt
- > HealthyRoad
- > Instituto Superior de Engenharia do Porto (ISEP)
- > Médis – Companhia Portuguesa de Seguros de Saúde, SA
- > Polytechnic Institute of Porto

Republic of Korea

- > ETRI (Electronics and Telecommunications Research Institute)
- > Neighbor Systems Co Ltd

Spain

- > HI Iberia Ingeniería y Proyectos

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September 2020

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