A potential of smart PPE in accident prevention and well-being at work on the examples of selected solutions

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Technological innovation and organisational changes: the potential impacts on prevention 29-31 March 2017, Nancy, France
1. Industry 4.0 and Internet of Things
2. Applications of IoT in OSH – smart PPE
3. A future role of smart PPE in Smart Working Environment
Industry 4.0

1st Industrial revolution
follows introduction of water- and steam-powered mechanical manufacturing facilities

2nd Industrial revolution
follows introduction of electrically-powered mass production based on the division of labour

3rd Industrial revolution
uses electronics and IT to achieve further automation of manufacturing

4th Industrial revolution
based on Cyber-Physical Systems

Smart Factory
Manufacturing system equipped with a context-awareness functionality that may assist people and machines in execution their tasks.
Internet of Things – next trend of Ubiquitous Computing

- Collecting, processing and data exchange by means of computer networks, particularly via the Internet
- Objects identified by their unique addresses
- IPv6 protocol for 128-bit addresses – a possibility to address up to $2^{128}$ devices
- Worldwide exponential growth of connected devices

Basic abilities of the interconnected objects:
- To be identifiable (everything identifies itself)
- To communicate (everything communicates)
- To interact (everything interacts)
State-of-the-art applications of IoT in OSH:

- Direct hazards for health and life
- Unpredictable and dynamic harsh and complex environment
- Workers’ protection can be guaranteed only by means of PPE

Smart PPE
Smart PPE - new functions

- Monitoring of environmental parameters
- Monitoring of worker’s health status
- Monitoring of worker’s location
- Warning signalisation
- Information support
- Adjustment of protective properties
- Monitoring of PPE life cycle
Smart PPE with monitoring functions

Intelligent PPE system for personnel in high-risk and complex environments

ICT applications:
- Monitoring of environmental hazards
- Monitoring of health status
- Wireless communication network

RFID-based network for PPE life cycle monitoring

- Control and supervision of PPE parameters during the working day
- Long – term monitoring of PPE "life cycle" focused on the economic aspect
Smart PPE with warning signalisation & information support

Welding helmet with Augmented Reality system

Signalisation of chemicals permeation through protective gloves

End-of-service-life indicator

- Sulphuric acid
- Sodium hydroxide
- Toluene
- Acetone
Smart PPE with adjustment of protective properties

- **Shape memory materials**
- **Ionic electro-active polymers**
- **Phase change materials**
- **Liquid cooling system**
- **Protective clothing against cold with active thermoregulation system**
From Narrowly Specialised Smart Systems towards integrated Cyber-Physical Systems

1st generation
Narrowly specialised embedded Smart Systems integrating sensing and activators as well as information processing for safety- and performance-focused actions

2nd generation
Predictive and adaptive Smart Systems with self-test capabilities able to match harsh, high-risk and complex environments

3rd generation
Higher level of integration of smart manufacturing objects with human-centered & ICT-based components of a Cyber-Physical System (CPS)

Degree of technology integration
Cyber-Physical System for symbiotic and safe collaboration between workers and machinery in Smart Working Environment

3rd Generation - Cyber-Physical Systems

- Integration of various autonomous smart PPE and manufacturing objects
- New approach to occupational risk management adjusted to SWE concept
Geographical location of a workplace & surrounding conditions, in which:

- Workers perform work-related tasks
- IoT technologies support monitoring of environmental parameters and interactions between workers and physical objects with an overarching goal to ensure workers’ safety and well-being
Vision Zero – a vision of a holistic, people-centred accident prevention strategy including safety, health and well-being at work

7 Golden Rules for VISION ZERO

- Leadership commitment
- Identify all hazards and risks
- Set safety and health targets
- Ensure a safe system
- Use safe and healthy technology
- Improve qualification
- Involve people

Attention not limited to workplaces but focused on people with their issues like aging, obesity or chronic diseases

http://immigrationimpact.com
Empowering the workforce with wearables towards (1/2):

- Smarter, safer and faster work
- Individualisation of processed information and taken measures
- Connection between humans and machines
- Effective and safe interactions of robots with people
- Integration of Human Factors into manufacturing

http://www.themmanufacturer.com
http://thegadgetflow.com
www.fraunhofer.de
Empowering the workforce with wearables towards (2/2):

- Taking full advantage of workers’ talent and knowledge for the benefit of business
- Optimisation of balance of people’s strength and limitations
- Upskilling

https://upskill.io  
www.inclusive-project.eu
A key challenge:
Workers’ acceptance

Expected impact:
• Speed up tasks
• Lower effort
• Improve quality
• Less rework
• Improve safety
• Better service
• Process flexibility

http://www.newspotng.com

www.banki.pl
Thank you very much for your attention

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