Convegno
LEADERSHIP E INNOVAZIONE: IL RUOLO DEI MANAGER PER LA SICUREZZA SUL LAVORO

Verso la “SafetyTech Sandbox” dell’Emilia-Romagna: tecnologie intelligenti e nuovi modelli di compliance

LA VALIDAZIONE SCIENTIFICA: Salute, Lavoro e Diritto

Focus: ***L’integrità psicofisica nell’era dell’interazione uomo-macchina***

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Dipartimento di Scienze Mediche e Chirurgiche,
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LAVORO
ATTIVITÀ
AMBIENTE

CARATTERISTICHE LAVORO	MISURE DI PREVENZIONE	MISURE DI PROTEZIONE	RISCHIO RESIDUO
HAZARD / PERICOLO - Identificare - Misurare	Ausili Protezioni Formazione	Collettive Individuali DPI	Misura e Monitoraggio

Applicazioni

Misurare esposizione	Valutare il rischio	Scelta misure	Monitoraggio
Forza Postura Movimento	Intensità forza Ampiezza e frequenza movimenti Frequenza cardiaca, respiratoria	Procedure operative Riorganizzazione Ausili / SMART DPI	Effetti Esigenze specifiche

Valutazioni scientifiche

LAVORATORE
POPOLAZIONE
LAVORATIVA

Raccolta dati ETÀ , SESSO ANTROPOMETRIA	VALUTAZIONE CAPACITÀ FUNZIONALE	VALUTAZIONE STATO DI SALUTE	DISABILITÀ

Possibili EFFETTI SULLA SALUTE

INFORTUNI

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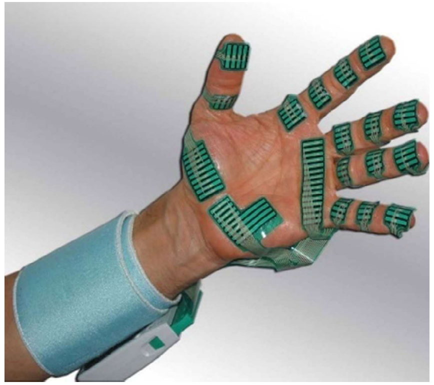
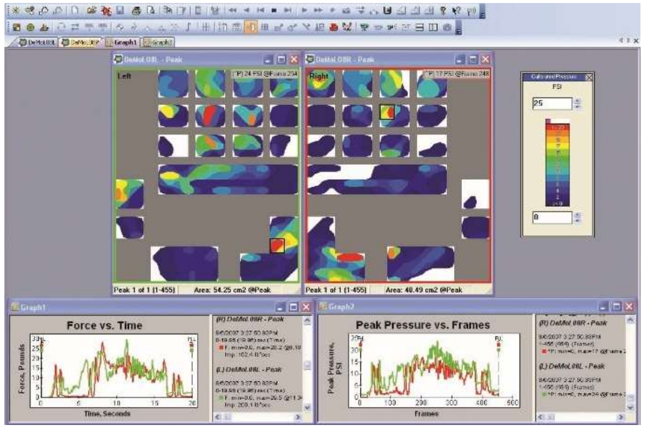
Calibrazione

Sistemi per la stima di forza e movimento

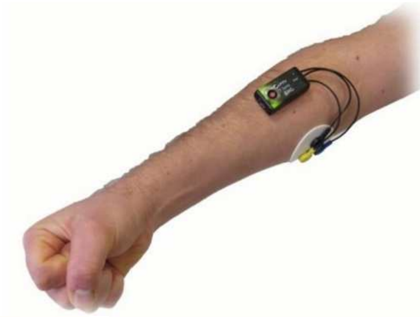
Calibrazione

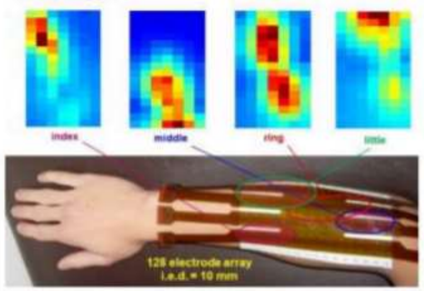
Sensori di pressione
Guanto Grip-system

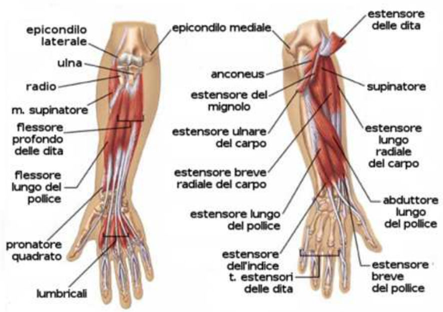




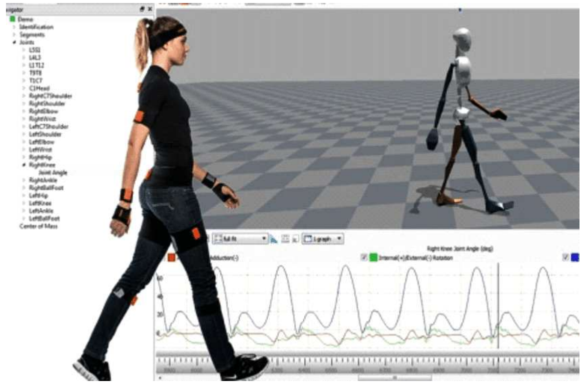
Elettromiografia (EMG) di superficie







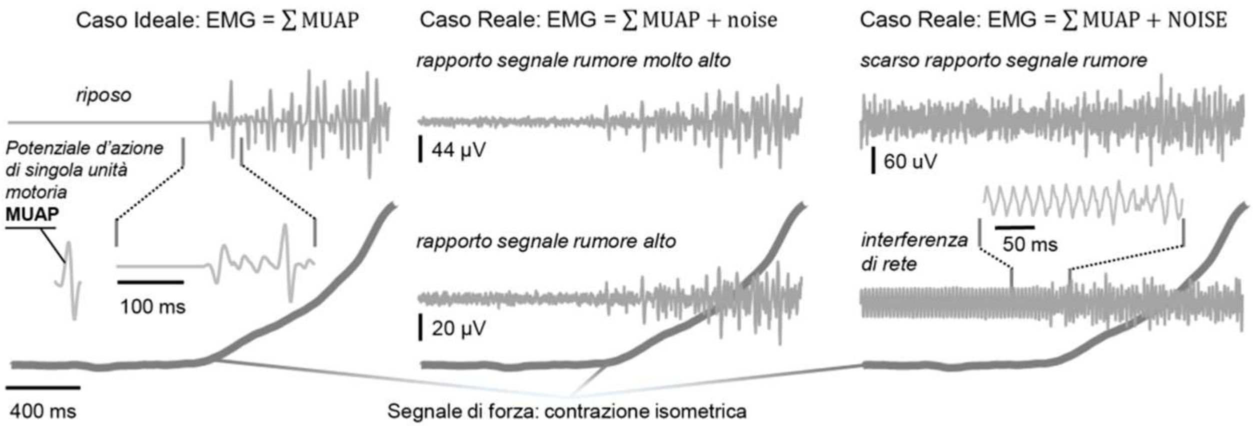
Postura,
movimento
Sensori inerziali

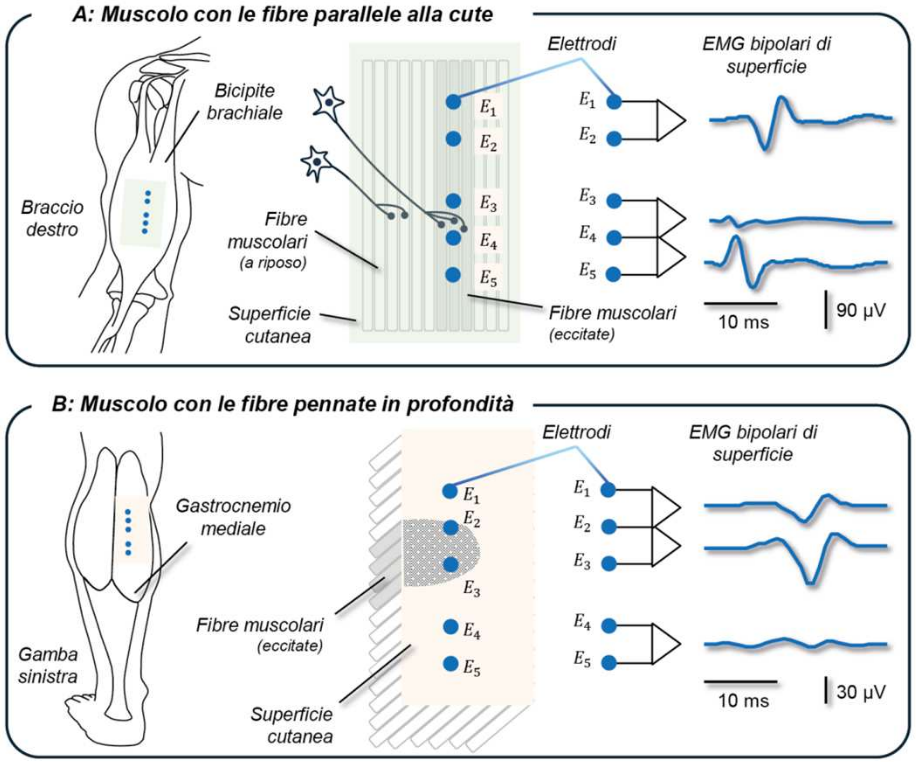


IMU
collegabili in
rete con
smartphone

Elettromiografia di superficie
Limiti

Posizionamento degli elettrodi
Caratteristiche del muscolo
Movimento





Rapporto AMPIEZZA
segnale / rumore fondo
segnale / interferenze

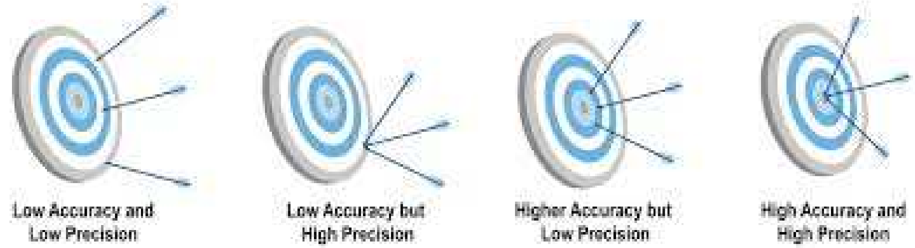
Giornale italiano di medicina riabilitativa Volume 40 – N.1 Marzo 2024
Elettromiografia di superficie: un approccio non invasivo per l'analisi dell'attività muscolare *V. AGOSTINI, I. CAMPANINI, C. DE MARCHIS, F. DI NARDO, A. MERLO, A. NARDONE, S. SCARANO, M. SERRAO, T. VIEIRA*

Sistemi per la misura di parametri fisiologici

Precisione e Accuratezza delle misure

Misurati

Derivati



- ECG
- Atti Respiratori
- Temperatura
- Accelerometria
- Tempo
- Posizione

- Frequenza Cardiaca
- Frequenza Respiratoria
- Variabilità Cardiaca
- Affidabilità Frequenza Cardiaca
- Impatti
- Attività
- Postura
- Consumo Calorico
- % Frequenza cardiaca (max)
- Parametri Soglie Aerobiche (HR, BR, HRR,VO2)

- Carico fisiologico e meccanico
- Carico da allenamento
- Salto
- Explosiveness
- Picco di intensità
- Picco di accelerazione
- Velocità (da GPS)
- Distanza (da GPS)
- Elevazione (da GPS)

- Affaticamento (Recupero HR)
- Prontezza (variabilità HR)
- Sicurezza (max HR, temperature, postura)
- Sovraccarico da allenamento
- Parametri Fitness (VO_2max, HR at AT)
- Fabbisogno calorico
- Agilità (accelerometria, velocità e distanza percorsa)
- Stress (Variabilità Cardiaca)

Sensori per la misura parametri per la valutazione dei rischi

sensors

MDPI

Article

On the OCRA Measurement: Automatic Computation of the Dynamic Technical Action Frequency Factor

Juri Taborri [1,*], Marco Bordignon [2], Francesco Marcolin [2], Alessandro Bertoz [2], Marco Donati [3] and Stefano Rossi [1]

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2 ErgoCert—Ente di Certificazione per l'Ergonomia srl, 33100 Udine, UD, Italy; marco.bordignon@ergocert.it (M.B.); francesco.marcolin@ergocert.it (F.M.); alessandro.bertoz@ergocert.it (A.B.)
3 Motustech—Sport & Health Technology c/o Marilab, 00121 Roma, RM, Italy; marco.donati@motustech.it
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check for updates

Abstract: OCRA (OCcupational Repetitive Action) is currently one of the most widespread procedures for assessing biomechanical risks related to upper limb repetitive movements. Frequency factor of the technical actions represents one of the OCRA elements. Actually, the frequency factor computation is based on workcycle video analysis, which is time-consuming and may lead to up to 30% of intra-operator variability. This paper aims at proposing an innovative procedure for the automatic counting of dynamic technical actions on the basis of inertial data. More specifically, a threshold-based algorithm was tested in four industrial case studies, involving a cohort of 20 workers. Nine combinations of the algorithm were tested by varying threshold values related to time and amplitude. The computation of frequency factor showed an average relative error lower than 5.7% in all industrial-based case studies after the appropriate selection of the time and amplitude threshold values. These findings open the possibility to use the threshold-based algorithm proposed here for the automatic computation of OCRA frequency factor, avoiding the time efforts in video analysis.

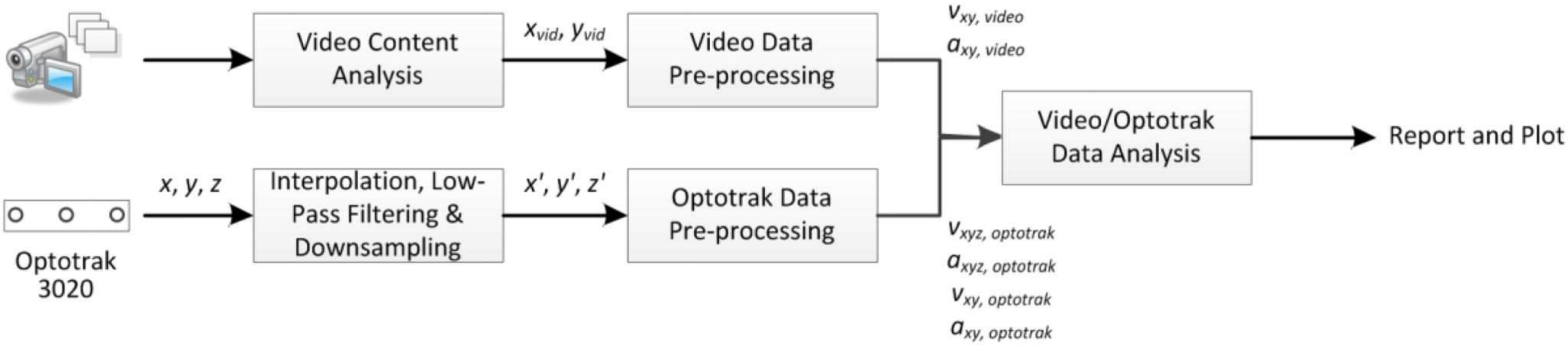
Keywords: OCRA; technical actions; upper limb musculoskeletal disorders; threshold-based algorithm; inertial sensors

Linear accelerations and angular velocities were gathered from 17 wearable inertial sensors (MVN Biomech Awinda, Xsens Technologies, The Netherlands)

The algorithm was based on two threshold values, related respectively to the time and the amplitude of the action identified in joint angle curves of the upper limbs.

Automatic computation OCRA Technical Actions

Validazione vs «gold standard» - Valutazione rischio da movimenti ripetitivi



This study demonstrated that **2D video tracking had sufficient accuracy** to measure **HAL (hand activity level) for ascertaining the American Conference of Government Industrial Hygienists Threshold Limit Value® for repetitive motion** when the camera is located within ±30 degrees off the plane of motion when compared against 3D motion capture for a simulated repetitive motion task.

ACGIH®
TLV® and BEI® Documentation

Chen et al. The accuracy of conventional 2D video for quantifying upper limb kinematics in repetitive motion occupational tasks. Ergonomics. 2015;58(12):2057-66

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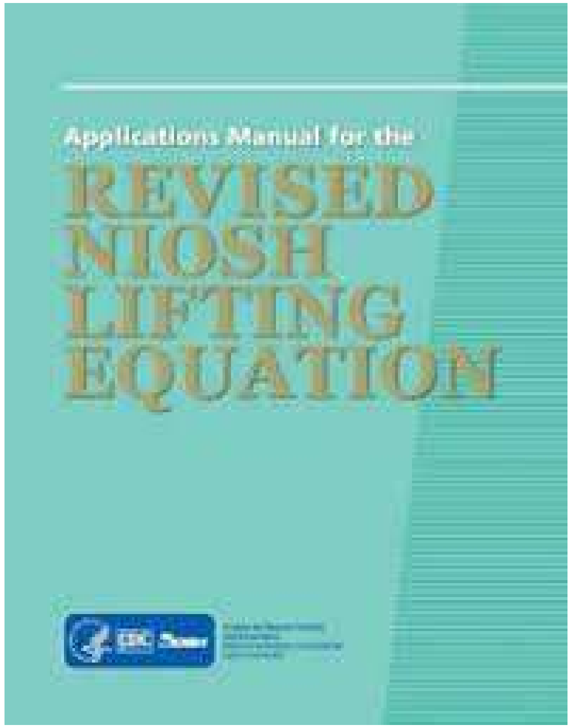
Validazione vs «gold standard» -
Valutazione rischio da movimentazione carichi

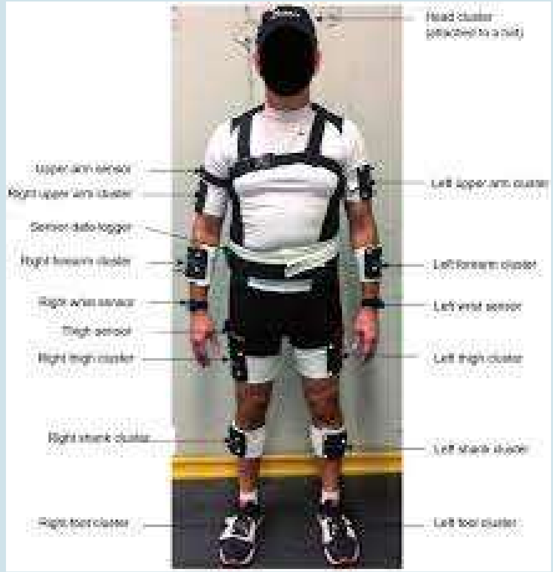


DHHS (NIOSH) Publication Number 94-110
Revised September 2021

Manuale ⇢ App ⇢ Algoritmo per video (2D)

Wang et al. The accuracy of a 2D video-based lifting monitor. Ergonomics. 2019 Aug;62(8):1043-1054

An algorithm for automatically calculating the revised NIOSH lifting equation using a single video camera was evaluated in comparison to laboratory 3D motion capture. The results indicate that this method has suitable accuracy for practical use and may be, particularly, useful when multiple lifts are evaluated



ENACTIVE INSOLE
Sensori di forza inseriti nella suola delle scarpe: spostamento del centro di pressione (COP)

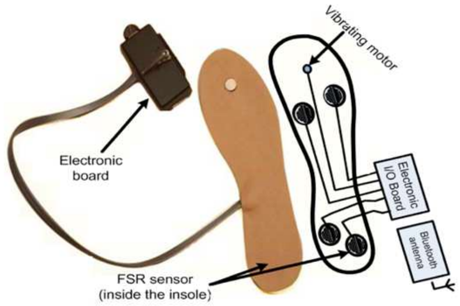


Figure 3. The prototype of the enactive insole with the preferred sensor location (the vibrating motor having the function of a rhythmic pattern is not used in this study).

SMART HELMET :
IMU
accelerometro +
giroscopio +
magnetometro

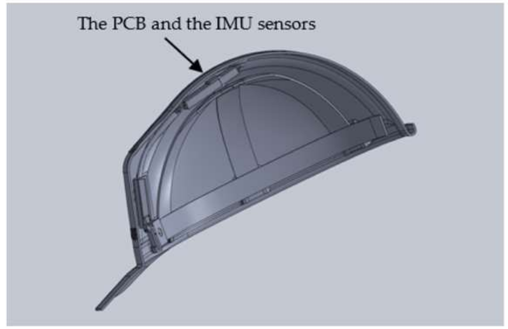


Figure 2. The instrumented safety helmet prototype.

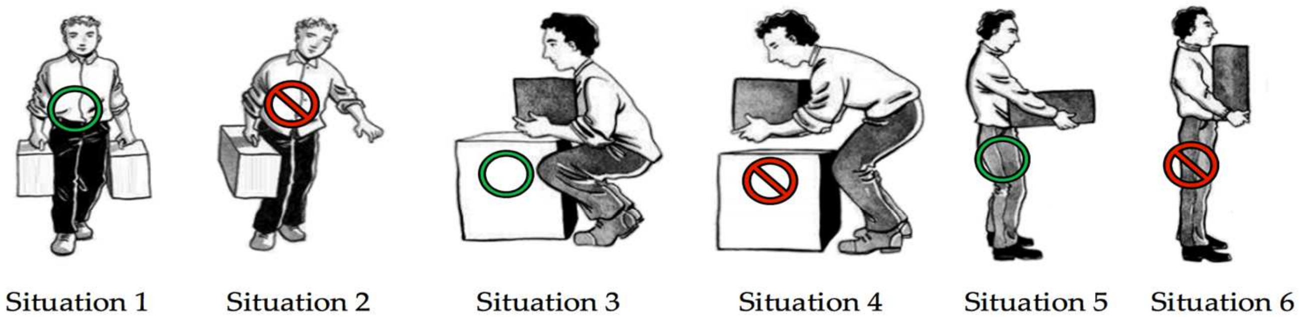


Figure 9. Six situations for evaluating adequate and inadequate posture for handling tasks, this figure is adapted from [53] with permission from Caroline Merola and the publisher.

- Automated assessment tool for posture analysis using specific features and artificial neural networks (ANN)
- **Detect inadequate postures of individuals in a work environment**.

Barkallah E, Freulard J, Otis MJ, Ngomo S, Ayena JC, Desrosiers C. Wearable
Devices for Classification of Inadequate Posture at Work Using Neural Networks. Sensors (Basel). 2017 Sep 1;17(9)

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Safety Science 170 (2024) 106368

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journal homepage: www.elsevier.com/locate/safety

ELSEVIER

Smart PPE in edilizia (2024)

offers a proactive approach to hazard identification and risk management.

Review

Smart Personal Protective Equipment (PPE) for construction safety: A literature review

Sina Rasouli [a], Yaghoub Alipouri [b,*], Shahin Chamanzad [c]

[a] Faculty of Civil Engineering, Sharif University of Technology, Tehran, Iran
[b] Construction Engineering and Management Department, Faculty of Civil Engineering, K.N. Toosi University of Technology, Tehran, Iran
[c] Faculty of Civil Engineering, Imam Khomeini International University, Qazvin, Iran

Utilizzo Corretto Allacciatura

Postura (IMU) Parametri vitali (EEG, ECG, FC, SO2)

Soletta tessile con sensori di pressione (P, COP)

Table 2
Criteria and conditions to enhance safety by using smart PPEs.

	Fall and impact incidents	Wearing status	Environmental conditions	Biometrics of workers	Proximity hazards	Pandemic-related hazards	Tool-PPE check system	Loss of balance
Helmet	*	*	*	*	*	*	*	
Vest	*		*	*			*	
Belt	*		*				*	
Shoes			*	*			*	*

Segnalare Cadute persona Caduta di oggetti

Rilevatori Parametri ambientali (T°, UR, UV ..) Sostanze pericolose (VOC, CO)

Alerts se un veicolo di avvicina (sensore RFID + antenna)

Verifica uso dispositivo: *optical pulse sensor, IMU, light-dependent resistor, LDR)* *Stretchable sensors*

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CARATTERISTICHE LAVORO	MISURE DI PREVENZIONE	MISURE DI PROTEZIONE	RISCHIO RESIDUO
HAZARD / PERICOLO - Identificare - Misurare	Ausili Protezioni Formazione	Collettive Individuali DPI	Misura e Monitoraggio

Applicazioni

Misurare	Valutare esposizione	Scelta misure	Monitoraggio
Forza Postura Movimento	Intensità forza Ampiezza e frequenza movimenti Frequenza cardiaca, respiratoria	Procedure operative Riorganizzazione Ausili / SMART DPI	Effetti Esigenze specifiche

Valutazioni scientifiche

Repeatability (Face validity)	Criterion validity Accuracy	Predictive validity	Valutazione efficacia
Le misure sono riproducibili? INTRA e INTER individuo	Gli strumenti di cui dispongo misurano il parametro di mio interesse? Confronto con «gold standard»	I risultati della valutazione sono in grado di prevedere il rischio? Studi prospettici	La misura adottata riduce l'effetto? Studi effectiveness?

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POPOLAZIONE
LAVORATIVA

Raccolta dati ETÀ , SESSO ANTROPOMETRIA	VALUTAZIONE CAPACITÀ FUNZIONALE	VALUTAZIONE STATO DI SALUTE	DISABILITÀ

Possibili EFFETTI SULLA SALUTE

INFORTUNI

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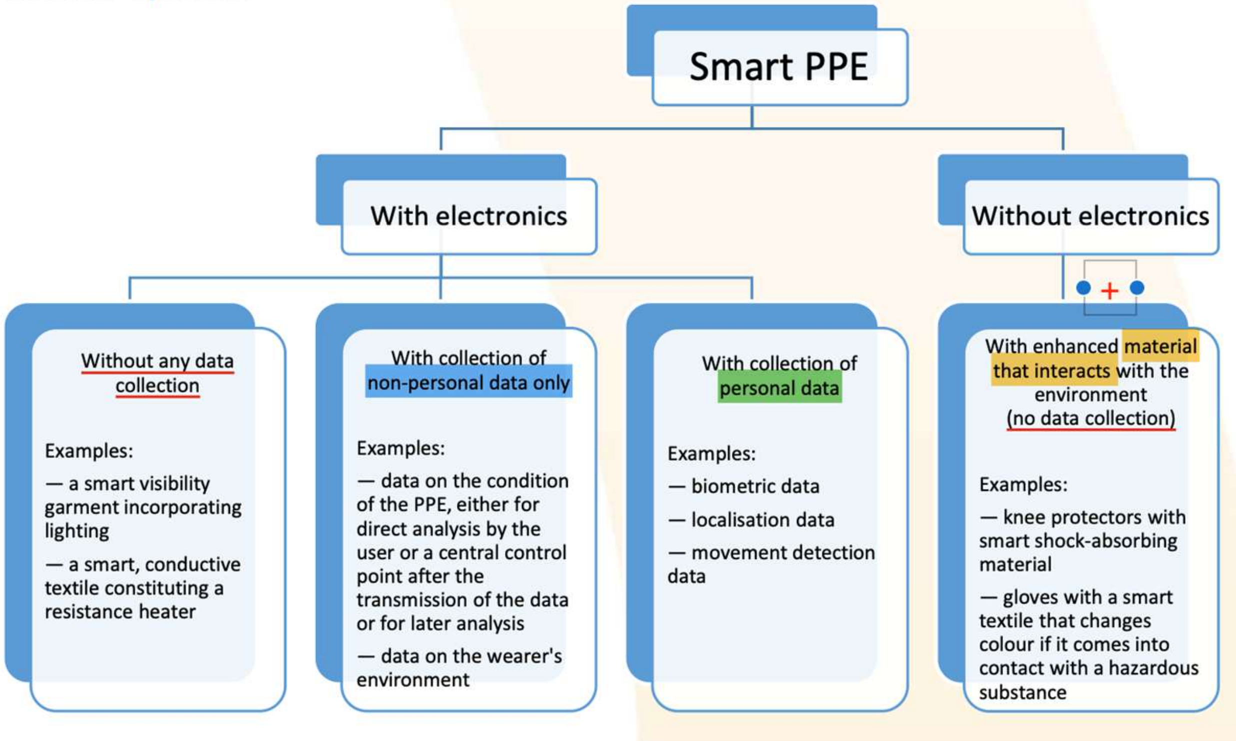
SMART Personal Protective Equipment

Smart PPE can be characterised by a certain degree of interaction with the environment or reaction to environmental conditions. The current proposal for a definition by the European Committee for Standardization (CEN) — the relevant European standardisation body — is as follows: Smart PPE is 'personal protective equipment that ... exhibits an intended and exploitable response either to changes in its surroundings/environment or to an external signal/input' (4).

Figure 1 Proposal for a classification scheme for types of smart PPE, according to composition and data collection capabilities



2020
https://osha.europa.eu/en/publications/smart-personal-protective-equipment-intelligent-protection-future

Challenges for legislation and standardisation

- Learning electronics
- The need for standards
- The hype phase seems to be over

Challenges related to users

- **Comprehensive information is a must** (mode of oparation, limits, mainteinance)
- **Future users' expectations (Data –less is more-, functionality, acceptability)**

Challenges posed by the new technology

- Work together with traditional PPE
- Medical devices
- Data protection (GDPR)


European Agency for Safety and Health at Work

DISCUSSION PAPER

SMART PERSONAL PROTECTIVE EQUIPMENT: INTELLIGENT PROTECTION FOR THE FUTURE

2020
https://osha.europa.eu/en/publications/smart-personal-protective-equipment-intelligent-protection-future

Requests and recommendations to stakeholders

- Policy-making (certification, recycling)
- Research and development
- Standardization (rules)
- Notified bodies (training)
- Users (be informed, train workers before use)
- Manufacturers (Cooperate with potential users on the development and design of smart PPE, provide transparent and detailed information

Occupational safety and health experts

- Gain competence in smart PPE
- Inform guide and train users

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Smart knee protectors

Smart shock-absorbing material can be soft and flexible, allowing normal movement such as walking (unlike traditional knee protectors, which are inflexible and hinder normal movement). However, in the event of a shock, the smart material's properties change and the shock-absorbing effect is revealed.

Smart, conductive textiles that constitute a resistance heater

Smart textiles can be conductive and thus have many applications, for example in a smart resistance heater in a garment. The conductive material is connected to an electrical power supply with a constant output voltage and equipped with a temperature sensor to maintain a constant temperature around the heater.

Smart lighting garments

Optical fibres integrated into textiles and connected to a controllable light source can be used as part of smart garments. Equipped with a sensor, these garments will be able to adjust illumination to the amount of light provided by other light sources in the vicinity of the smart garment.

Smart gloves capable of identifying hazardous substances

Chromogenic material take on a different colour depending on an external stimulus (e.g. heat, light, enzymes). This can be used in smart gloves that change colour when they come into contact with hazardous substances.

An example of collision warning equipment, © Linde Material Handling GmbH

European Agency for Safety and Health at Work

DISCUSSION PAPER

SMART PERSONAL PROTECTIVE EQUIPMENT: INTELLIGENT PROTECTION FOR THE FUTURE

2020

https://osha.europa.eu/en/publications/smart-personal-protective-equipment-intelligent-protection-future

Smart PPE that communicates with other (potentially hazardous) products

PPE can be equipped with detectors that communicate with corresponding detectors in other products in the vicinity of the wearer. Thus, situations that are to be prevented because they present a risk can be avoided. Such smart PPE can be used to avoid collisions with mobile machinery such as forklift trucks. Another example is smart PPE worn by operators of machinery that ensures that the machine starts working only when the operator is in the designated operator station.

Smart PPE that collects data about its own use

PPE can be equipped with sensors that collect data on use duration or quantity and communicate with a central database. Maintenance cycles can be monitored automatically. For example, the user could be informed when maintenance, a regular inspection or the replacement of the PPE or parts thereof is required.

Sensor-based airbag for protection against critical injuries of cervical/spine column due to a fall

Appropriate airbag and electronic components including assessment logic can be integrated into work wear and fulfil its function in case it is activated by a sensor system which detects a hazardous stimulus. Such a stimulus could be the set of velocity and (angular) acceleration that indicates the fall from a ladder.

Sistemi digitali intelligenti - Migliorano la sicurezza sul lavoro fornendo informazioni sulle condizioni di lavoro in modo proattivo

- Essenziale l'uso trasparente della tecnologia per mantenere e rafforzare la fiducia dei lavoratori, rispondere alle preoccupazioni relative alla privacy, al trattamento dei dati e all'eccessiva dipendenza dalla tecnologia.
- Coinvolgere i lavoratori e i loro rappresentanti nella progettazione, nell'uso e nella corretta gestione dei dati dei sistemi digitali intelligenti: conoscenza e accettazione
- Utili a integrare, non a sostituire, altre misure di sicurezza e salute sul lavoro (adattamenti postazione di lavoro, formazione, promozione della fiducia)
- Necessario aggiornamento e adeguamento normativo/ certificativo per promuovere l'integrazione in un sistema efficace di gestione della SSL, basato sulla responsabilità del datore di lavoro e nel contesto della gerarchia dei controlli.
- Gli strumenti e le tecnologie digitali intelligenti, come i dispositivi indossabili, possono sostenere l'inclusione e la diversità rispondendo alle esigenze di specifici gruppi di lavoratori


Safety and health at work is everyone's concern. It's good for you. It's good for business.

Healthy Workplaces
SAFE AND HEALTHY WORK IN THE DIGITAL AGE

Smart digital systems for better safety and health at work

Key points

- Smart digital systems improve workplace safety by providing insights into working conditions in a proactive way that has only recently become possible.
- Transparent use of technology is essential to maintain and build workers' trust and to address concerns about privacy, data handling and over-reliance on technology.
- Involving workers and their representatives in the design, use and sound data management of smart digital systems is important, as it increases their acceptance and buy-in to on the technologies. This promotes workers' health and well-being.
- Smart digital systems should complement other occupational safety and health (OSH) measures, such as workplace adaptations, worker training and fostering trust, rather than being relied upon as the sole solution.
- Legislation and labour inspections must evolve to keep pace with smart digital systems to promote their integration into an effective OSH management system, based on employer responsibility and in the context of the hierarchy of controls.
- Smart digital tools and technologies like wearables can support inclusion and diversity by addressing the needs of specific worker groups.

Safe and healthy work in the digital age

The European Agency for Safety and Health at Work (EU-OSHA) is running the 2023–2025 Europe-wide Healthy Workplaces Campaign to raise awareness of the implications of digital technologies for safety and health at work. If designed, implemented, managed and used in line with a human-centred approach, digital technologies can be safe and productive. As the use of these technologies at work continues to increase and their impact on work and workplaces is still not fully understood, it is important to understand how to fine-tune strategies that promote and protect workers' safety and health.

iStock - Natnan Srisuwan

2025 https://osha.europa.eu/en/publications/smart-digital-systems-better-safety-and-health-work

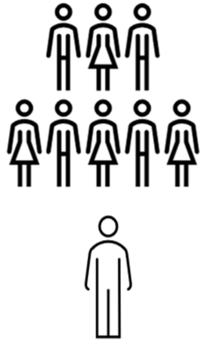
Positive implications for OSH

By providing real-time data, predictive insights and even actionable recommendations, smart digital systems can help companies to adopt a proactive approach to OSH, anticipating risks, preventing accidents and safeguarding their workforce. They can particularly support companies for:

- Improved compliance with OSH regulations (e.g. through real-time data on the proper use of personal protective equipment (PPE).
- Better-informed decision-making, by generating **accurate and fast OSH information** (parameters) and the use of predictive algorithms.
- More effective enforcement through the identification of risks at an aggregated level.
- Increased training opportunities in virtual reality environments.
- Greater accessibility for workers with specific needs (e.g. ageing workers or those with health conditions) and overall improvements in workforce well-being.

Smart digital systems enable risk identification and early detection, which lead to the prevention or avoidance of harm. The range of risks includes individual and collective harmful exposures and environmental levels, exposure to ergonomic risks, plant- and premise-related risks, hazardous worker behaviour, poor individual health and well-being and psychosocial risks.

In practice, smart digital systems often **serve multiple OSH purposes by combining more than one digital technology and integrating several functions**.



Close cooperation between the designer and the implementer, a mutual understanding of needs and priorities, and dialogue at the workplace between employer and workers are all vital to ensuring the successful implementation of the solution.

2025 https://osha.europa.eu/en/publications/smart-digital-systems-better-safety-and-health-work

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Challenges for OSH

Despite the positive aspects, there are risks and challenges that need to be considered.

- The use of collected data may have limitations, such as inaccuracies or difficulties in interpretation, and may fulfil aims that differ from OSH prevention.
- Smart digital systems may also create new hazards or increase existing risks. For instance, physical and safety risks may arise if the systems malfunction, are hacked by cyberattacks, cause explosions or if there is an over-reliance on digital OSH monitoring at the expense of other OSH procedures.
- Also, frustration over equipment malfunctions, solitary, monotonous, or repetitive tasks, the continuous monitoring of workers required by the digital system, the lack of skills or training to use them, and the frequent warnings generated by the digital technologies, are all psychosocial risks that can be associated with increased stress and other mental health issues.

Smart OSH monitoring systems may blur OSH responsibility, particularly if the control hierarchy is not respected. Collective safety measures should not be overtaken by a focus on personal control measures. There is also a need to consider data privacy and protection.

2025 https://osha.europa.eu/en/publications/smart-digital-systems-better-safety-and-health-work

The workplace as a data-rich environment

The more intrusive the data collection, the greater the need for worker engagement. Specific measures will vary depending on the system but must address what data is gathered, and how it is stored and processed. Two key approaches are:

1. **Privacy by design**, which includes data anonymisation, minimisation, GDPR compliance and secure storage.
2. **Privacy by choice**, which restricts data access to specific roles (e.g. OSH professionals).

Smart digital tools, as part of the broader OSH framework, transform the workplace into a data-rich environment, raising concerns about worker data privacy and potential personal data misuse.

Concerns about data privacy or misuse may be seen as workers' resistance to new technologies. However, concerns about employers gaining access to more personal aspects of workers' lives, including mental health, are serious. This highlights the need to involve workers and their representatives to consider their needs and concerns, and take them into account when introducing new smart digital systems. There is also the need to transparently inform workers and their representatives about how these systems function, and what the implications are for them. Employers need to ensure that proper training, coaching and feedback are provided to workers to support the use and management of these systems.

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 2025 https://osha.europa.eu/en/publications/smart-digital-systems-better-safety-and-health-work

Caratteristiche di un dispositivo di protezione

Dalla PROTEZIONE alla PREVENZIONE proattiva

PPE/DPI

D.Lgs. 81/2008 – art. 76
Requisiti dei DPI

CONFORMITA’
- Conformi alle norme (Reg. UE n. 2016/425).

ADEGUATEZZA / SICUREZZA
- Adeguati ai rischi da prevenire, senza comportare di per sé un rischio maggiore;
- Adeguati alle condizioni esistenti sul luogo di lavoro;

CONFORT
- Tenere conto delle esigenze ergonomiche o di salute del lavoratore;

ADATTABILITA’
- Poter essere adattati all’utilizzatore secondo le sue necessità.

ACCETTABILITA’

Interferenze

Normativa

Dispositivi medici
*DMIA DMI

Età, sesso
Disabilità

Formazione

Tutela privacy

SMART PPE/DPI INTELLIGENTE

CONFORMITA’
Standardizzazione
Procedure verifica
Certificazione

Materiali
Elettronica
Alimentazione
Trasmissione
Interferenze

ADEGUATEZZA / SICUREZZA
Sicurezza elettrica
Batteria
Campi elettromagnetici (EMF/EMC)

Manutenzione / Pulizia
Monitoraggio funzionalità

ACCETTABILITA’
Conoscenza
Utilizzo
Potenzialità e limiti

Approccio PARTECIPATIVO
gestione
Fattori psicosociali

ADATTABILITA’
Ergonomia
Praticità
Ingombro/carico

***Dispositivi Medici Impiantabili Attivi (DMIA)** *(PM, defibrillatori, impianti cocleari)*
***Dispositivi medici indossabili (DMI)** *(microinfusori di farmaci, apparecchi acustici ..)*

LEGGE 20 maggio 1970, n. 300 Norme sulla tutela della libertà e dignità dei lavoratori, della libertà sindacale dell'attività sindacale, nei luoghi di lavoro e norme sul collocamento.

Art. 4 (Impianti audiovisivi e altri strumenti di controllo)

STRUMENTO DI CONTROLLO
PER LA SICUREZZA DEL LAVORO
- previo accordo rappresentanze sindacali
- (autorizzazione organi ispettivi ASL/IDL)

1. Gli **impianti audiovisivi e gli altri strumenti dai quali derivi anche la possibilità di controllo a distanza dell'attività dei lavoratori** possono essere impiegati esclusivamente per **esigenze organizzative e produttive**, **per la sicurezza del lavoro** e per la **tutela del patrimonio aziendale** e possono essere installati previo accordo collettivo stipulato dalla rappresentanza sindacale unitaria o dalle rappresentanze sindacali aziendali. In alternativa, nel caso di imprese con unità produttive ubicate in diverse province della stessa regione ovvero in più regioni, tale accordo può essere stipulato dalle associazioni sindacali comparativamente più rappresentative sul piano nazionale.
((In mancanza di accordo, gli impianti e gli strumenti di cui al primo periodo possono essere installati previa autorizzazione delle sede territoriale dell'Ispettorato nazionale del lavoro o, in alternativa, nel caso di imprese con unità produttive dislocate negli ambiti di competenza di più sedi territoriali, della sede centrale dell'Ispettorato nazionale del lavoro. I provvedimenti di cui al terzo periodo sono definitivi.))

STRUMENTO DI LAVORO
PER RENDERE LA PRESTAZIONE

2. La disposizione di cui al comma 1 non si applica agli **strumenti utilizzati dal lavoratore per rendere la prestazione lavorativa e agli strumenti di registrazione degli accessi e delle presenze.**

CONFORMITA' NORME SULLA
TUTELA DEI DATI PERSONALI

3. Le informazioni raccolte ai sensi dei commi 1 e 2 sono utilizzabili a tutti i fini connessi al rapporto di lavoro a condizione che sia data al lavoratore adeguata informazione delle modalità d'uso degli strumenti e di effettuazione dei controlli e nel rispetto di quanto disposto dal decreto legislativo 30 giugno 2003, n. 196 (smi D. Lgs. n. 101/2018, Regolamento Generale sulla Protezione dei Dati (GDPR - Regolamento UE 2016/679)

LEGGE 20 maggio 1970, n. 300
Statuto dei lavoratori

Art. 4 (Impianti audiovisivi e altri strumenti di controllo)

C1. **STRUMENTO DI CONTROLLO PER LA SICUREZZA DEL LAVORO**
- previo accordo rappresentanze sindacali
- (autorizzazione organi ispettivi ASL/IDL)

C2. **STRUMENTO DI LAVORO PER RENDERE LA PRESTAZIONE**

C3. **CONFORMITA' NORME SULLA TUTELA DEI DATI PERSONALI**

Art. 9 (Tutela della salute e dell'integrità fisica) - *I lavoratori, mediante loro rappresentanze, hanno diritto di controllare l'applicazione delle norme per la prevenzione degli infortuni e delle malattie professionali e di promuovere la ricerca, l'elaborazione e l'attuazione di tutte le misure idonee a tutelare la loro salute e la loro integrità fisica.*

DL garante obbligo di sicurezza (CC art. 2087 (Tutela delle condizioni di lavoro).

L'imprenditore è tenuto ad adottare nell'esercizio dell'impresa le misure che, secondo la particolarità del lavoro, l'esperienza e la tecnica, sono necessarie a tutelare l'integrità fisica e la personalità morale dei prestatori di lavoro.

OBBLIGAZIONE DI SICUREZZA IN CAPO AL DL

«Autonomia» del dispositivo intelligente

Dati personali (principi di raccolta, trattamento e conservazione)
Dati sensibili (sanitari, trattamento solo se in circostanze giustificate e previo consenso)

D. Lgs. n. 101/2018 adegua il Codice in materia di protezione dei dati personali (DLgs 196/2003) al Regolamento Generale sulla Protezione dei Dati (GDPR - Regolamento UE 2016/679) Art 5, Art 9

ENTE ITALIANO DI NORMAZIONE

UNI/TR 11858:2022

Tecnologie IoT nell'impiego dei DPI - Indicazioni relative **all'integrazione di sistemi elettronici** nella gestione e nell'utilizzo dei dispositivi di protezione individuali

- Inclusione
- Compatibilità
- *Personalizzazione (successiva, da certificare)*

Certificati dal fabbricante

«AI ACT» garantire sicurezza e conformità agli standard etici

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

Industry 5.0 "provides a vison of industry that aims beyond efficiency and productivity as the sole goals and reinforces the role and the contribution of industry to society

It complements the existing "Industry 4.0" approach by specifically putting research and innovation at the service of the transition to a sustainable, human-centric and resilient European industry.

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Original article

Industry 6.0: Vision, technical landscape, and opportunities

Ashwin Verma [a,1], Vivek Kumar Prasad [a,1], Aparna Kumari [a,1], Pronaya Bhattacharya [b,1], Gautam Srivastava [h,i,j], Kai Fang [c,*], Wei Wang [f,g], Thippa Reddy Gadekallu [c,d,e]

The limitations of Industry 5.0 makes it inevitable to propose a shift not optional but inevitable. …Industry 6.0, therefore emerges as the minimum viable platform for factories that must **create, heal, and trade resources in real time**—pushing the industrial frontier from automated to **truly autonomous**, adaptive, and sustainable.

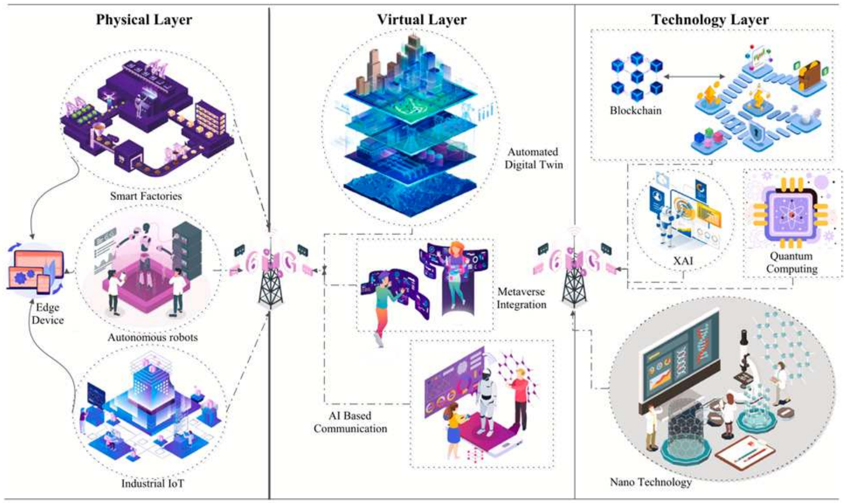

Fig. 3. Architecture of Industry 6.0.

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