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Editorial

Special Issue: "Novel Approaches and Applications in Ergonomic Design II"

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1. Introduction

The appropriate design of human–system interactions is crucial for ensuring safety, usability, productivity, and well-being. The advent of technologies like affective artificial intelligence, cloud computing, the Internet of Things, big data analytics, autonomous vehicle technology, robotics, and wireless technology in the fourth industrial revolution has spurred ergonomists and human factors professionals to innovate new design methodologies and solutions for harmonizing the physical, digital, and biological realms. This Special Issue aims to showcase novel approaches and applications from diverse fields, amplifying the dissemination of researchers' endeavors towards improved ergonomic designs. Out of 18 submissions, 13 papers have been published, and each is summarized briefly below.

2. Design of 3D Microgestures for Commands in Virtual Reality or Augmented Reality

Integrating a human factor approach into the design of gestures, along with gesture recognition that optimizes latency and accuracy, is vital for facilitating effective interactions between humans and VR/AR systems. Li et al. [1] designed and evaluated a set of 3D microgestures for virtual and augmented reality commands. The researchers recruited 40 participants with experience using touch or mid-air gestures to interact with smart devices. The participants completed an initial questionnaire and then performed a series of tasks using the proposed microgestures. The researchers analyzed the data and found that the proposed microgestures were both popular and effective, with high user preference and accuracy rates. The study contributes to the field of human–computer interaction by providing a set of microgestures that can improve the efficiency and intuitiveness of interacting with virtual and augmented reality environments. The findings suggest that microgestures can be a viable alternative to traditional input methods, such as touch screens or controllers, and can potentially enhance user experience in various industries, such as gaming or healthcare.

3. Speech Characteristics as Indicators of Personality Traits

Language can serve as a valuable lens through which we can gain insight into the social and psychological characteristics of its users, including their personality traits. Lee et al. [2] investigated whether language characteristics such as discourse markers, pitch, intensity, or response time can be valuable indicators of various personality traits. The study collected the semi-natural conversations of 30 individuals from South Texas, all native speakers of English, and analyzed them using various linguistic and statistical methods. The major findings of the study suggest that certain speech characteristics are linked to specific personality traits, such as introversion and extroversion. The study's major contributions include highlighting the potential of speech analysis as a tool for personality assessment and providing insights into the relationship between language and personality. The study provides a promising avenue for future research in the field of personality assessment and speech analysis.

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4. Applying Wearable Technology and a Deep Learning Model to Predict Occupational Physical Activities

Due to the significant variation in physical demands among different occupations, physical demand analyses are utilized for pre/post-offer employment evaluations, facilitating return-to-work processes, and determining the necessary personal protective equipment. Yan et al. [3] aimed to develop a deep learning model that could predict occupational physical activities (OPAs) using wearable technology. The researchers collected kinematic data from eight participants wearing eight different IMUs on various body segments while performing OPAs that are common in manual material-handling jobs. The trained model was used to predict the OPAs performed in three simulated work tasks, and the predictions were validated using a frame-by-frame analysis of video recorded during the tasks. The results showed that the deep learning model accurately predicted OPAs with an average accuracy of 92.5%. The major contribution of this study is the development of a novel approach to predicting OPAs using wearable technology and deep learning, which has the potential to improve workplace safety and efficiency in various industries.

5. Preliminary Validation of a Low-Cost Motion Analysis System Based on RGB Cameras to Support the Evaluation of Postural Risk Assessment

Utilizing cost-effective tools for direct posture monitoring and continuous ergonomic risk assessment during work can mitigate ergonomic hazards and promote the well-being of workers in the workplace. Agostinelli et al. [4] introduced the development and initial validation of an affordable motion analysis system based on RGB cameras which was designed to facilitate the assessment of postural risks. The validation of the RGB camera motion analysis system was achieved through a comparison of its results with those obtained from a conventional motion analysis setup, revealing a strong correlation between the two systems. The primary findings of this study underscore the reliability and validity of the low-cost motion analysis system for evaluating postural risk while also demonstrating its potential applicability across various domains, including occupational health, safety, sports medicine, and rehabilitation. The significant contributions of this research lie in presenting a low-cost alternative to established motion analysis systems and in showcasing the feasibility of leveraging RGB cameras for motion analysis.

6. Evaluation of Picker Discomfort and Its Impact on Maintaining Strawberry Picking Quality

The body posture of strawberry pickers has a significant impact on not only stheir health, working comfort, and productivity but also on the quality of the harvested fruit. Komarnicki et al. [5] explored the correlation between picker discomfort and the quality of harvested strawberries. This research comprised two stages: field tests and laboratory tests. During the field tests, a portable Tekscan system measured surface pressures exerted on harvested fruit, while an sEMG recorded picker muscle tensions. Laboratory tests examined the firmness of 45 selected strawberries. The findings indicated that picker discomfort adversely affects fruit quality by increasing surface pressure and reducing firmness. This study's primary contribution lies in identifying the connection between ergonomics and fruit quality, providing insights for interventions to enhance both picker comfort and fruit quality. The study also emphasizes the necessity for further research into the impact of additional ergonomic factors on fruit quality.

7. Development of an Ergonomic User Interface Design of Calcium Imaging Processing System

An ergonomic user interface (UI) design can enhance the efficiency and usability of calcium-imaging processing systems for neuroscience researchers. Jung et al. [6] developed an ergonomic UI design for calcium-imaging processing systems used in neuroscience research. The ergonomic UI design was devised for a novel optical brain–machine interface (O-BMI) system through three stages: (1) the identification of user design and functional requirements, (2) the establishment of a usage scenario, and (3) the development of a UI

prototype. The study employed a literature review, the benchmarking of existing systems, and a focus group interview with five neuroscience researchers to identify UI design requirements. A digital prototype was then crafted and evaluated by five neuroscientists and five ergonomic experts, comparing it with four existing systems. Results indicated that the ergonomic UI design significantly reduced task completion time, scan path length, and perceived workload while enhancing satisfaction in data acquisition and signal extraction tasks. Further research is needed to validate the usability of the UI design with a broader group of researchers and functioning systems.

8. Predicting User's Measurements without Manual Measuring: A Case on Sports Garment Applications

Stretchable sports clothing employs specific sizing due to elasticity; customized measurements lack the possibility of returns, while fitting sets encounter challenges within the realm of online retail. Vleugels et al. [7] devised a methodology for the anticipation of user measurements without manual intervention, specifically for applications involving sports garments. Through the integration of 3D scanning, shape modeling, and regression analysis, the authors formulated a predictive model that rests upon a user's age, weight, and stature. The research encompassed 37 subjects, including 10 professional cyclists from the Flemish region, who underwent scanning and measurements facilitated by a bespoke clothing ensemble and diverse measuring instruments. The findings underscored the accuracy of the predictive model, attesting to variances within a 1–2 cm range for most measurements. Consequently, the model demonstrated potential utility in enhancing garment selection for customized sports attire. Despite its advancements, the study acknowledges the limitations inherent in the utilization of linear shape models and the dependence on self-reported data for specific measurements. The study represents a significant contribution to the field of sports garment design and could have important implications for the future of made-to-order sports garments.

9. A Method for Generation of a Sizing System and Representative Models for a Facial Mask Design

A facial mask sizing system anchored in facial anthropometric measurements is crucial for accommodating users with diverse face sizes. Lee et al. [8] developed a comprehensive sizing system along with representative facial models (RFMs) for oxygen masks intended for Korean Air Force (KAF) pilots. The study addressed the imperative of refining mask fit for KAF pilots, thereby establishing a comprehensive sizing system and identifying RHMs that seamlessly integrate important facial dimensions, user friendliness, and economic efficiency. The study obtained the facial measurements of KAF pilots, established a sizing system through a distributed representative human model generation and analysis system, and identified RHMs using a principal component analysis. A custom sizing system consisting of four distinct categories was generated for a pilot oxygen mask, and for each of these sizing categories, the RFM was identified based on the minimum value of the weighted sum of Euclidean distance (WSED) criterion. The study underscores the integrated consideration of multifaceted factors, spanning user friendliness and economic viability, into the intricate matrix of mask design.

10. Analysis of Leg Muscle Activities and Foot Angles While Pressing the Accelerator Pedal by Different Foot Postures

Automobile manufacturers prioritize enhancing cars' acceleration for customer satisfaction and brand distinctiveness as acceleration significantly influences satisfaction and purchase decisions. Tjolleng et al. [9] investigated the impact of natural and rotated foot postures on leg muscle activities and foot angles while pressing the accelerator pedal during driving. The study conducted an experiment with 20 healthy participants who drove a car in a parking area while their muscle activities, foot motions, and pedal strokes were recorded. The results revealed that the rotated foot posture increased the muscle activities of the tibialis anterior and gastrocnemius muscles while decreasing the muscle activities

of the soleus and medial gastrocnemius muscles. Conversely, the natural foot posture led to less muscle activity for the tibialis anterior and gastrocnemius muscles but more muscle activity for the soleus and medial gastrocnemius muscles. Foot angles were also influenced by foot postures, with the rotated foot posture resulting in a more dorsiflexed ankle joint and a more extended knee joint. In contrast, the natural foot posture yielded a more plantar-flexed ankle joint and a more flexed knee joint. These findings can be used in designing new accelerator pedals and driver training programs that consider the effects of foot postures on leg muscle activities and foot angles during driving.

11. Occupational Footwear Design Influences Biomechanics and Physiology of Human Postural Control and Fall Risk

The foot's role as a link to the environment underscores its importance in somatosensory feedback and balance, with potential impacts on stability from improper footwear and occupational regulations. Derby et al. [10] presented a review of a series of studies conducted by the authors on the different effects of work boots on postural stability, gait, slips, muscle activity, heart rate, energy expenditure, oxygen consumption, and pain perception. The research assessed biomechanical and physiological variables associated with different types of work boots and their design features to provide recommendations for optimal human performance. The studies included testing of three types of work boots: high-top steel-toed, high-top tactical, and low-top slip-resistant. Using simulated workloads, the studies evaluated postural control and locomotion impact. The studies found that design elements like slip resistance, ankle support, and shock absorption can enhance postural stability and decrease fall risk. The studies also found that different types of work boots can influence muscle activity, energy use, and pain perception. The reviewed studies contribute by emphasizing proper work boot selection, modification, and design to mitigate fall and injury risks in occupational settings. These findings can inform the design of safe and comfortable work boots, enhancing workers' well-being across industries.

12. Ergonomics Evaluation Using Motion Capture Technology—Literature Review

The prevalence of manual activities in production processes, coupled with the trend of an aging workforce, heightens the risk of musculoskeletal disorders or work-related injuries due to improper postures. Motion capture technology offers objective risk assessment. Rybnikár et al. [11] conducted a systematic literature review on the use of motion capture technology in ergonomics from 2010 to 2022. Employing a systematic review approach, 107 scientific publications were selected after evaluating their relevance, quality, and alignment with the research purpose. The study highlighted the potential of motion capture technology for evaluating ergonomics in manual activities by providing accurate and objective data on workers' movements and postures, aiding the identification of ergonomic risk factors and the development of interventions to reduce the risk of musculoskeletal disorders. This literature review provides valuable insights into the practical application of motion capture technology in ergonomics evaluations.

13. Assessment of Musculoskeletal Pain and Physical Demands Using a Wearable Smartwatch Heart Monitor among Precast Concrete Construction Workers: A Field Case Study

The physical demands inherent in construction work, such as frequent lifting, handling heavy loads, bending, twisting, assuming static positions, exposure to vibrations, and coping with harsh weather conditions, amplify the risk of musculoskeletal disorders in the workplace. Arias et al. [12] evaluated musculoskeletal pain and physical demands in precast concrete construction workers through the utilization of a wearable smartwatch heart monitor. The study involved workers engaged in tasks related to wall panels, beams, columns, and hollow core slabs. Pain severity and functional limitations were gauged using a questionnaire, while a smartwatch heart monitor was employed to quantify physical demands. The findings revealed pronounced levels of musculoskeletal pain and physical demands among precast concrete workers, and the lower back, shoulders, and knees were

particularly affected. The principal contribution of this study lies in furnishing invaluable insights into the physical demands that construction work entails and their repercussions on workers' well-being. These insights can serve as a foundation for enhancing worker safety and overall health.

14. Reducing Lumbar Flexion in a Repetitive Lifting Task: Comparison of Leukotape and Kinesio Tape and Their Effect on Lumbar Proprioception

Excessive lumbar flexion during lifting tasks is a common cause of lower back pain. Grütters et al. [13] conducted a comparative assessment of Leukotape and Kinesio Tape to determine their effectiveness in diminishing lumbar flexion and their influence on lumbar proprioception during repetitive lifting tasks. The study involved 12 healthy participants who performed a repetitive lifting task before and after taping interventions. The results of the study showed that both tapes significantly reduced lumbar flexion during the lifting task, but Leukotape was more effective than Kinesio Tape. However, neither tape exhibited a significant effect on lumbar proprioception. The study provides empirical evidence for the effectiveness of taping interventions in reducing lumbar flexion during lifting tasks, thereby potentially contributing to the prevention of lower back pain.

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