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Emerging Trends in Industry 4.0 with Innovative Case Study of Human Balance & Rehabilitation Engineering

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Abstract

Industry 4.0 has evolved from a perception of smart factories to include value chain (i.e. manufacturing, production, logistics, supply chain and Internet of Things (IOT)). Many companies are leading the transformation toward Industry 4.0 based on innovation by Cyber-Physical System (CPS). CPS Systems integrate computation, networking and physical processes that will provide new functionalities to improve quality of life and enable technological advances in critical areas. Besides CPS, transformative technologies impacting Industry 4.0 are Machine-to-machine learning, Big-Data analysis, Cloud computing, Mobile internet, Autonomous vehicles and advanced materials. Industry 4.0 is also influenced by extensive application of Enhanced Visualization and Simulation, Additive Manufacturing, Smart Automation and Augmented Reality. The combination of Internet technologies and future-oriented technologies in (machines & products) based on advanced digitalization results in a new fundamental paradigm shift in Industry. This paper includes a case study demonstrating the impact of Industry 4.0 - including the integration of CPS in Human Balance and Rehabilitation Engineering. Growing health care needs have seen the introduction of Artificial intelligence and data science integrated into tele-sensing of vital signs. Sensory perception and model-based decision making has helped the study of human gait to assist in balance. This case study involves impaired populations involving stroke survivors, fall-prone elderly, vestibular loss sufferers and amputees using an ambulatory suspension system. The case study demonstrates the use of sensory perception, data collection and the use of body support system such as an Ambulatory Suspension System for decision making on balance. These technologies are reordering the global industry structure, creating new markets, products, improving labor productivity and driving growth in advanced economies. These technologies have enormous impacts on predictive maintenance, improved decision-making in real-time, real-time inventory and improved flexibility among jobs.

Keywords
Cyber-physical systems, Internet of Things, Ambulatory Suspension System

Biographies

Devdas Shetty Ph.D, P.E joined the University of the District of Columbia in 2012, having previously served as Dean of Engineering at Lawrence Technological University and Dean of Research at the University of Hartford. While with the University of Hartford, Dr. Shetty was first Chair of the Vernon D. Roosa Endowed Professorship. In addition, he was the Director of the Engineering Applications Center, through which he established partnerships with more than 50 Connecticut industries. During 2008 and 2009, Dr. Shetty served as Dean of the College of Engineering for Lawrence Technological University in Michigan, where he initiated several new academic programs, established partnerships and contributed to curricular innovation. Dr. Shetty is the author of three books and more than 200 scientific articles and six patents. His books on Mechatronics and Product Design are widely used as a textbooks in many universities around the world. Dr. Shetty's research work has been cited for original contribution to the understanding of engineering surface measurement, for significant intellectual achievements in mechatronics and for contributions to product design. He is well-known for his contributions in establishing partnerships between the University and industries. He is the recipient of academic and research grants from organizations like National Science Foundation, Society of Manufacturing Engineers, US Army, Air force etc. partnership with Albert Einstein College

of Medicine in New York, he invented the patented mechatronics process for supporting patients. He is an elected member of the Connecticut Academy of Science and Engineering.

Saul B. Henderson is a graduate research assistant focusing on Wireless Communications and Cyber-Physical Systems within the Electrical Engineering department at the University of the District of Columbia (UDC). Prior to joining the Master's program in August 2019, Saul has gained over 6 years of valuable experience and soft skills in STEM research, design and informal education. He has gained 5 years of education experience as a student educator at the Smithsonian National Air and Space Museum (NASM), where he was responsible for interacting with thousands of visitors daily by educating them on the basic principles of aerodynamics, flight systems and space travel. Saul has also spent 2 years of his undergraduate career as a research assistant in several areas including Machine Learning, Power Systems and Mechatronics. In this capacity, he spent most of his time working under his school dean, Dr. Devdas Shetty, to enhance labs and higher-level coursework with hands-on mechatronics projects and robotics. Saul has recently obtained his B.S in Electrical Engineering with a concentration in Computer Engineering from UDC in May 2019, where he graduated with honors.