School of Computing, Engineering, and the Built Environment
Edinburgh Napier University

PHD STUDENT PROJECT

Application instructions:
Detailed instructions are available at :
https://www.napier.ac.uk/research-and-innovation/doctoral-college/how-to-apply

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- DIRECTOR OF STUDY: Dr Gokula Vasantha (Email: g.vasantha@napier.ac.uk)
- 2ND SUPERVISOR: Dr Adelaide Marzano

Subject Group: Engineering & Mathematics

Research Areas: Engineering

Project Title: Development of VR-based Real-time Feedback System for Net-Zero Manufacturing Operations

Project description:

The Engineering and Mathematics Group within the School of Computing, Engineering and the Built Environment is inviting applications for a Doctor of Philosophy (PhD) in developing a VR-based real-time feedback system for net-zero manufacturing operations.

Accurate real-time performance assessment of a manufacturing factory is complex due to multiple manufacturing parameters from operators, materials, processes, equipment, and environment influencing the production outcomes. With IoT commonly available in the industry, the research challenge posed by digital manufacturing is not the capture of data but rather the lack of computational methods to analyse large flows of diverse (i.e. multimodal) sensor data. Manufacturers are interested in developing data-driven tools and techniques to monitor manufacturing units in real-time and develop intelligent, proactive feedback strategies to improve performances. This Doctor of Philosophy (PhD) research project aims to develop virtual reality (VR) based real-time system modelling

techniques that proactively analyse multimodal sensor data, assess manufacturing factory performance, develop feedback mechanisms for improvement strategies, and evaluate the impact of proposed improvements.

The project focuses on the following research objectives: (i) develop automated manufacturing process models based on multimodal factory data and integrate seamless to VR factory model (that includes integrated manufacturing system such as mobile robot, flexible manufacturing system and operators), (ii) develop real-time factory performance operational model through automated IoT data, (iii) develop VR enabled feedback mechanisms on performance assessment and improvements, and (iv) assess net-zero implications in the developed VR-enabled feedback system.

Since improving manufacturing factory economic and environmental performances is the core objective, this research requires an excellent understanding of manufacturing systems, system engineering principles, data analytics, and machine learning (i.e., predictive modelling) techniques. Furthermore, the research involves a complete data processing cycle, such as multimodal manufacturing data collection with appropriate sensors (e.g. worker's movement, machine temperature and vibration), data integration, data cleaning and data transformation. Therefore, it would be ideal if the candidate has experience in big data analytics or system simulation modelling software such as Seimens Plant Simulation and advanced programming skills.

The researcher joining this project will have the opportunity to work within the Flexible Manufacturing Laboratory at Edinburgh Napier University, gaining valuable experience and training in the appropriate technical areas. They will be actively encouraged to present their work at leading international conferences, enhancing their professional profile. The researcher will also benefit from collaborating with Professors at the University of Edinburgh and Strathclyde through an ongoing EPSRC (The Engineering and Physical Sciences Research Council, UK) funded research project (EP/V051113). This project offers a unique opportunity for a motivated and intellectually curious individual to make a significant contribution to the field of manufacturing systems.

Perspective applicants are encouraged to contact the Supervisor before submitting their applications. When applying, please make it clear that you are applying for the 'VR-based real-time feedback system for net-zero manufacturing operations' project and include the names of the supervisors. We look forward to receiving your applications.

References:

1. "Hierarchical Ensemble Deep Learning for Data-Driven Lead Time Prediction", A. Aslan et al., The International Journal of Advanced Manufacturing Technology, Vol. 128, Issues 9-10, 2023.

2. "Using Worker Position Data for Human-Driven Decision Support in Labour-Intensive Manufacturing", A. Aslan et al., Sensors, Vol. 23, No. 10, Article 4928, 2023.

3. Smarter Facility Layout Design: Leveraging Worker Localisation Data to Minimise Travel Time and Alleviate Congestion, A. Aslan et al., (2024, accepted), International Journal of Production Research (IJPR).

4. Safer and Efficient Factory by Predicting Worker Trajectories Using Spatio-Temporal Graph Attention Networks, Kasarapu, S. S. K., et al. (2024, accepted). International Design Engineering Technical Conferences & Computers and Information in Engineering Conference Proceedings of the ASME IDETC-CIE 2024.

Candidate characteristics

Education:

A first degree (a minimum 2:1) in Mechanical Engineering, Manufacturing, Computer Engineering, Mechatronics Engineering, Engineering Science, Data Science, Operational Science

Subject knowledge:

Data analytics, Manufacturing systems, Performance analysis, Operational research

Essential attributes:

- Experience of fundamental manufacturing systems and processes
- Competent in data analytics and statistical techniques
- Knowledge of simulation processes and prediction approaches
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

- Experience in virtual reality application development