



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: Prof. Xiaodong Liu (Email: x.liu@napier.ac.uk)
- 2ND SUPERVISOR: tbc

Subject Group: Computer Science

Research Areas: Artificial Intelligence, Internet of Things, Machine Learning

Project Title: An AI-driven approach to proactive Internet of Things (IoT) based systems

Project description:

The Internet of Things (IoT) refers to the ever-growing network of physical objects such as smart devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to interact autonomously and intelligently. IoT is the foundation of so-called smart systems which provide critical services in many emerging application domains such as smart home, smart city, energy supply and traffic management. IoT based smart systems is creating huge new markets and solutions to improve our economy, society and life. They have been a key drive in many economic sectors and many parts of the society and people's life.

However, when use the actual smart systems in practice, people often feel that the system is not that smart as they expected or as advocated by the vendors. Disappointingly, the systems often produce very limited or even wrong response to the user need. The current research on building the smart systems is still quite basic and leaving the current smart systems with no or little learning abilities to

understand the user need at an appropriate deep level. This problem becomes worse because user needs are usually dynamic, i.e. changing from time to time. Furthermore, the advances of sensors and computing technologies plus the wide spectrum of application domains have made these smart systems very diverse, large and complex.

In this PhD project, the successful candidate will explore the current state of the art on software architecture and Internet Of Things and then develop a new approach to endorsing the proactive learning ability to the IoT and therefore enable these smart systems to provide resilient and adaptive services that best match the dynamically changing user needs. The approach will provide a key solution to one of the greatest concerns of the current IoT-based smart systems.

Applications from potential part-time students are also welcomed.

References:

Context-Active Resilience in Cyber Physical Systems (CAR)", EU H2020 Marie Skłodowska-Curie Actions – European Fellowships Project, Coordinator, 2016-2018, <http://www.msca-car.eu/>

Yang, Z., Wu, H., Liu, Q., Liu, X., Zhang, Y., & Cao, X. A self-attention integrated spatiotemporal LSTM approach to edge-radar echo extrapolation in the Internet of Radars. ISA Transactions, Elsevier, Vol 132, 2022

Liu, Q., Kamoto, K. M., Liu, X., Zhang, Y., Yang, Z., Khosravi, M. R., Qi, L. A Sensory Similarities Approach to Load Disaggregation of Charging Stations in Internet of Electric Vehicles. IEEE Sensors Journal, 21(14), <https://doi.org/10.1109/jsen.2020.3027684>, 2020

Qi Liu, Kondwani Michael Kamoto, Xiaodong Liu, Mingxu Sun, Nigel Linge. Low-Complexity Non-Intrusive Load Monitoring Using Unsupervised Learning and Generalized Appliance Models. IEEE Transactions on Consumer Electronics, 65(1), 1-1, 2019

Daren Fang, Xiaodong Liu, Imed Romdhani and Claus Pahl, An agility-oriented and fuzziness-embedded semantic model for collaborative cloud service search, retrieval and recommendation. Future Generation Computer Systems, Elsevier, Vol. 56, Issue C, pp 11-26, 2016

Candidate characteristics

Education:

A first degree (at least a 2.1) ideally in Computer Science with a good fundamental knowledge of software engineering, or artificial intelligence or Internet Of Things.

Essential attributes:

- Experience of fundamental software design and development
- Competent in design of Internet Of Things applications
- Knowledge of software architecture
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

- Some knowledge of machine learning would be beneficial