PhD Advert Template

Project title: Development of Cognitive Digital Twin for Predictive Maintenance of Building Facilities

Project ID *(optional)*: *Please leave blank*

Accept all year-round applications

Funding information: Self-funded students only

Project description:

**About the project:**

As an emerging concept, digital twins have been adopted to save costs and improve reliabilities in many different industries, including the Architecture, Engineering and Construction (AEC) industry. As the dynamic digital representation of a real-world counterpart, the digital twin can unleash great value if applied across the whole life cycle of the asset of interest.

Post-construction maintenance of building systems plays a critical role in reducing the operational carbon footprint of buildings in the UK, which made up 18% of the UK’s total emissions in 2019. Collecting data throughout the asset lifecycle allows the digital twin to better predict the remaining service life and remaining energy-efficient life of components. In this way, a predictive maintenance strategy can be implemented, avoiding downtime and optimising system reliability and energy performance. In this project, the digital twin will be developed, with augmented cognitive capabilities to capture the characteristics and status of a component and how it interacts with other components in a complex multi-component system. Leveraging semantic technologies such as ontology and knowledge graphs, the idea of the cognitive digital twin will be explored, to track the through-life degradation of an asset or process.

The candidate will conduct the research based on the data from the intensively monitored Urban Sciences Building, located on Newcastle Helix in the heart of the city. As a living laboratory underpinning research to make urban centres more sustainable for future generations, the building contains over 4,000 digital sensors, providing high resolution data about environmental, mechanical and electrical performance. Engagement with wide industrial partners, like Siemens, is expected to expand the impact of research.

**Prerequisites:**

Essential: Applicants will normally hold a first or 2:1 undergraduate degree or a master’s degree in a subject relevant to the research project.

Desirable: Knowledge of building information modelling, building facility management and machine learning; strong programming skills and willingness to learn semantic web technologies.

*Newcastle University is committed to being a fully inclusive Global University which actively recruits, supports and retains colleagues from all sectors of society. We value diversity as well as celebrate, support and thrive on the contributions of all our employees and the communities they represent. We are proud to be an equal opportunities employer and encourage applications from everybody, regardless of race, sex, ethnicity, religion, nationality, sexual orientation, age, disability, gender identity, marital status/civil partnership, pregnancy and maternity, as well as being open to flexible working practices.*

References (optional):

Xie, X., Merino, J., Moretti, N., Pauwels, P., Chang, J. and Parlikad, A., 2022. Digital twin enabled fault detection and diagnosis process for building HVAC systems. Automation in Construction.

Xie, X., Moretti, N., Merino, J., Chang, J., Pauwels, P. and Parlikad, A., 2022. Enabling Building Digital Twin: Ontology-Based Information Management Framework for Multi-source Data Integration. Proceedings of the 22nd CIB World Building Congress. <https://doi.org/10.17863/CAM.83062>

Xie, X., Lu, Q., Herrera, M., Yu, Q., Parlikad, A.K. and Schooling, J.M., 2021. Does historical data still count? Exploring the applicability of smart building applications in the post-pandemic period. Sustainable Cities and Society, 69, p.102804. <https://doi.org/10.1016/j.scs.2021.102804>

Lu, Q., Xie, X., Parlikad, A.K. and Schooling, J.M., 2020. Digital twin-enabled anomaly detection for built asset monitoring in operation and maintenance. Automation in Construction, 118, p.103277. <https://doi.org/10.1016/j.autcon.2020.103277>

Application enquires: *Xiang Xie*[*https://www.ncl.ac.uk/nuact/fellows/profiles/xiangxienewcastleacuk.html*](https://www.ncl.ac.uk/nuact/fellows/profiles/xiangxienewcastleacuk.html)

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Agriculture

[ ]  agricultural sciences

[ ]  agricultural technology

[ ]  arable farming

[ ]  livestock farming

[ ]  forestry & arboriculture

[ ]  other

Anthropology

[ ]  biological anthropology

[ ]  social anthropology

[ ]  other

Architecture, Building & Planning

[ ]  architecture

[ ]  built environment

[ ]  construction management

[ ]  landscape architecture

[ ]  rural planning

[ ]  surveying

[ ]  urban planning

[ ]  other

Biological Sciences

[ ]  bacteriology

[ ]  behavioural biology

[ ]  biochemistry

[ ]  biodiversity

[ ]  bioinformatics

[ ]  biophysics

[ ]  biotechnology

[ ]  cancer biology

[ ]  cell biology

[ ]  developmental biology

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[ ]  environmental biology

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[ ]  microbiology

[ ]  molecular biology

[ ]  molecular genetics

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[ ]  parasitology

[ ]  plant biology

[ ]  plant cell biology

[ ]  reproductive biology

[ ]  structural biology

[ ]  systematic biology

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[ ]  zoology

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Business & Management

[ ]  accounting

[ ]  business

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[ ]  human resource management

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Chemistry

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Communication & Media Studies

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[ ]  journalism

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Computer Science

[ ]  artificial intelligence

[ ]  computer architectures

[ ]  computer vision

[ ]  computer graphics

[ ]  cyber security

[x]  data science

[ ]  human computer interaction

[ ]  internet of things

[ ]  machine learning

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Creative Arts & Design

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Economics

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Education

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Engineering

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Environmental Sciences

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Finance

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Food Sciences

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Forensic and Archaeological Sciences

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Geography

[ ]  agricultural geography

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History & Archaeology

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Information Services

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Languages, Literature & Culture

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Law

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Linguistics & Classics

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Materials Science

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Mathematics

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Nursing & Health

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Philosophy

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Physics

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Politics & Government

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Psychology

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Sociology

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Sport & Exercise Science

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Theology & Religious Studies

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Veterinary Sciences

[ ]  animal welfare

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