

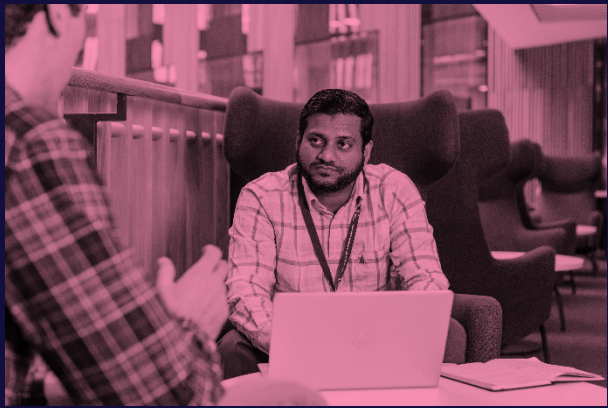


School of Computing

Research and Innovation Annual Report
1 August 2023 - 31 July 2024

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1. FOREWORD

Research Director
Dr Ian Cleland



It is with great pride that I present the Annual Research Report for the School of Computing, covering the academic year 2023–2024. This year we have continued to witness a global boom in artificial intelligence (AI) that is reshaping industries and societies. With over three decades of expertise in AI research, the School of Computing is uniquely positioned to contribute to and capitalise on these developments. Our sustained focus on key areas including healthcare, bioinformatics, cybersecurity, and digital mental health has enforced our reputation as a leader in the field, while opening new opportunities for impactful research and innovation.

The School achieved remarkable success this year, with 7 PhD graduates, 181 peer reviewed publications and over £18M in research funding secured. A key initiative in this is the launch of the Artificial Intelligence Collaboration Centre (AICC), a five-year initiative funded for £16.3M by the Department for the Economy and Invest Northern Ireland. The AICC aims to accelerate AI-powered solutions for Northern Irish businesses, providing expertise, training, and skills development to drive economic growth and technological advancement. Other key projects within the School include the partnership with PwC through the Advanced Research Engineering Centre (ARC), a cornerstone of our work in Generative AI. Over the past year, ARC produced six proof-of-concept demonstrators addressing areas like financial crime detection, process automation, and synthetic data generation. Another notable achievement was the launch of Phase 2 of the BT Ireland Innovation Centre (BTIIC) in April 2024, focusing on AI for services, operational insights, and secure IoT systems. BTIIC's contributions earned a shortlist nomination for Emerging Technology of the Year at the UK IT Industry Awards. Together, these initiatives highlight the School's leadership in driving innovation through academic and industry collaboration.

This year also marked significant growth in our doctoral training portfolio, with two major programmes broadening our scope and reach. The EPSRC-funded Tech4Health Centre for Doctoral Training, launched in collaboration with the School of Engineering and University College London, represents a transformative investment in digital health technologies. With £11.7 million in funding, the Centre will train 75 PhD researchers over the next eight years, equipping them to address critical healthcare challenges with innovative solutions. Meanwhile, NILab, a BBSRC-funded doctoral training programme in partnership with Queen's University Belfast, focuses on integrating AI with biosciences. Supporting 60 PhD researchers from diverse backgrounds, NILab aims to develop expertise at the intersection of these disciplines. These initiatives demonstrate our commitment to developing the next generation of researchers capable of advancing AI and healthcare.

As we look to the future, the conclusion of the Connected Health Innovation Centre (NI-CHIC) marks a significant transition. Over its 13-year tenure, NI-CHIC delivered more than 70 projects in collaboration with 64 member companies, leveraging £65 million in funding to drive healthcare innovation. It now transitions into the £42 million Centre for Digital Health Technology (CDHT) under

the Belfast Region City Deal. CDHT will combine expertise across computing, engineering, biotechnology, and healthcare to tackle global challenges such as rising healthcare costs and healthy aging. This transition is further supported by the £55 million investment in the Future Medicines Institute and £2.4M EPSRC Place Based Impact Acceleration Account STREAM 1. Digital Healthcare Technology Impact Accelerator (DHTA) positioning the School and Ulster University as a global leader in healthcare innovation.

The School's research outputs this year have been equally impressive, with extensive publications in leading journals such as the IEEE Sensors Journal, npj Mental Health Research, and the Decision Analytics Journal. These publications reflect the breadth of our research, covering topics as diverse as digital mental health interventions to AI decision-making frameworks. Our contributions to science have also been showcased through six major conferences hosted by the School, including the 35th Irish Signals and Systems (ISCC2024), the 2nd International Digital Mental Health and Wellbeing Conference, the 23rd UK Workshop on Computational Intelligence (UKCI 2024), the 8th International Conference on Belief Functions (BELIEF 2024) and the 16th International Conference on Ubiquitous Computing and Ambient Intelligence (UCAmI 2024). These events have served as vital platforms for global knowledge exchange, further cementing our role as a leader in computing and AI research.

“With a commitment to excellence in AI, digital health, and secure and sustainable computing, we are aiming to address global challenges through innovative solutions.”

The School continues to excel in knowledge exchange and business partnerships. Recognition at the Innovate UK KTP Awards underscores the impact of these projects, with former KTP Associate, turned PhD Researcher, Kate Turley being named a Future Leader for her work with Chroma Lighting. This year also saw the partnership with Kainos grow further. Tom Gray, Kainos's Chief Technology Officer, was appointed as Visiting Professor of AI and Innovation within the School, reflecting the strength of our collaboration. Kainos's support includes funding for two PhD researchers investigating explainable, trustworthy, and ethical AI, demonstrating the mutual benefits of these partnerships. Kainos has already attributed over £1.9M in new business to its collaboration with the School, a testament to the value of our research.

Looking ahead, the School is deeply engaged in preparations for REF2029, focusing on impactful and interdisciplinary research. With a commitment to excellence in AI, digital health, and secure and sustainable computing, we are aiming to address global challenges through innovative solutions. With REF2029 in mind, the School focus is on promoting a strong research culture, through initiatives including the School Research Seminar series, training for ECRs, and networking and training events for PhD researchers and contract researchers.

Further details of our research, facilities, staff profiles, and research expertise can be found at [Computer Science and Informatics Research](#) or by contacting **Mrs Ursula MacDonald** (Academic Excellence Executive Assistant) at: **Email:** u.macdonald@ulster.ac.uk; **Tel:** +44 28 9536 5759.



Dr Ian Cleland
Research Director, School of Computing

2. RESEARCH STUDENTS

| NAME | PROJECT TITLE |
|-------------------------------------|---|
| Aaqib, Muhammad | An IoT trust and reputation framework in an Edge Environment |
| Agboluaje, Babatunde | Artificial Intelligence and Augmented Reality Applications in Biomedical Engineering Education |
| Ahmad, Salman | Novel Data Analytics to Automatically Detect Patterns in Diverse Customer Data |
| Alam, Gulzar | An Approach for Curating and Sharing Open Data Sets in Human Activity Recognition |
| Ali, Muhammad Asim | Explainable and Transparent Imbalanced Learning (ETIL) |
| Black, Brendan | A meshed synchronous internet of medical things |
| Cameron, Gillian | Digitalising Employee Assistance Programmes - Evaluating the effectiveness and efficacy of digital mental health interventions in the workplace |
| Casement, Ainsley | Technology adoption: - Using Diffusion of Innovation to identify key learning points to increase adoption rates |
| Clare, Conor | Bayesian optimization using Student-t processes with gradient information |
| Donaghy, Philip | Discovering and understanding speech-derived vocal biomarker patterns related to mental health sciences |
| Ennis, Andrew | Situation aware content provisioning in mobile environments |
| Farrelly, Eoin | Explainable Semi-Supervised Learning and Applications (ESSL) |
| Gebresilassie, Samson Kabsay | BTIIC-10: Managing Identities and risk in an Internet of Insecure devices |
| Han, Tonghui | Text representation, feature engineering and sentiment analysis. Using statistical meta-features. |
| Haque, Radowanul | Cross Project Software Defects |
| Haseeb, Abdul | Leveraging Artificial Intelligence on Resource Constrained Devices for Digital Health Solutions |
| Hyzy, Maciej | Using data science techniques to analyse quality assessment data of digital health apps |

| | |
|--------------------------------|---|
| Imad, Muhammad | Deep learning approaches for contextual aware anomaly detection |
| Iqbal, Yasir | Trustable computation offloading to digital twin in resource-constrained IoT |
| Jasinska-Piadlo, Alicja | A data science approach to understanding heart failure. |
| Kirk, Nathan | Sensing and Modelling Air Quality for Healthy Living (SMAQ) |
| Li, Nan | Hybrid Reasoning Methods Based on Dynamic Fuzzy Concepts with Uncertainty |
| Lyu, Jialin | DeepMeta: Deep multiplexed metagenomics approach to biomarkers discovery and explanation of Covid-19 severity |
| Majid. | Synthetic Data Generation |
| McAllister, Anna | Mathematical Modelling of Predator-Prey Systems |
| McCalmont, Graham | Wearable Technologies to Support the Assessment of Physical Activity Functions for Stroke Rehabilitation |
| McConomy, Gareth | Human-centred and ethical AI practices for industry |
| McHugh, Orla | Decision Analytic with Combined Data Driven Models and Domain Knowledge for Sustainable Land Management |
| Merwick, Fiachra | Advancing Time Series Analysis through Deep Learning and Quantum Computing |
| Nolan, Kevin | Predicting Chaos with Machine Learning |
| O Fithcheallaigh, Sean | Efficient Federated Learning: Strategies to Enhance Model Efficiency, Address Data Heterogeneity, and Optimise Communication Schemes |
| O'Hare, Stefan | Sensing human emotion within pervasive environments |
| O'Neill, Christopher | Detecting Anomalies from Space Data sources by Deep Learning Data Analytics |
| Pavlovic, Maja | Anomaly Detection in MBES, SWARM and SENTINEL-3 Data using Data Analytics |
| Rabbani, Kashif | BTIIC-11: Information SLAs for IoT Systems |
| Ross, Stephen | Novel Machine Learning Modelling utilizing Experimental and Farm Data for Higher Efficiency and Lower Green House Gas Emission Dairy Production |
| Rutayisire, Tonny | Human Mobility Modelling with Integrative Learning for Intelligent Transport Systems |

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|----------------------------|---|
| Saunders, Catherine | SPACES: Self-Properties Autonomic Computing for Exploring Space |
| Sempey, Ciara | Automated Recognition of Emotional Wellbeing and Personal Needs |
| Sun, Yi | Video anomaly Detection Method Based on Deep Learning |
| Turley, Kate | Environmentally affective IoT solutions to assist with healthy ageing |
| Vincent, Jordan | Spectral Pattern Recognition |
| Wang, Dongwei | Intelligent Process Automation |
| Xu, Lixian | Interpretable Data-Knowledge Integrated AI Models with Application in Civil Engineering |
| Ye, Jing Hua | Intelligent Multimodal Affective Computation |
| Zi, Bingxin | AI Assistant Robots for Supporting Independent Living |
| Zou, Yishan | Intelligent retrieval of video streams based on target behavior |



GRADUATED DEC 2023

| NAME | PROJECT TITLE |
|----------------|--|
| McGuigan, Liam | Autonomic pulse communications for adaptive transmission range and data transfer in decentralised robot swarms |
| Shewell, Colin | Leveraging machine-vision for activity recognition utilising indoor localisation to support aging-in-place |

GRADUATED JULY 2024

| NAME | PROJECT TITLE |
|------------------|---|
| Asharinda, Fayas | Enhancing Low Quality Spectral Data Analytics for Food Quality Control |
| D'Arco, Luigi | Novel AI-Empowered Smart Insole-Based Approaches for Activity Recognition and Gait Analysis |
| Chen, Zhi | Big Data TV Analytics for Service and Customer Improvement |
| Kamal, Rashid | Personalising and Predicting Breakpoints for Notifications on Mobile Devices |



3. RESEARCH OUTPUTS

This section reports those outputs published and/or delivered over the period of this report and classified as either: journal articles, books/chapters in books, research reports, published conference papers, or live conference contributions. <https://pure.ulster.ac.uk/>.

3.1. JOURNAL ARTICLES

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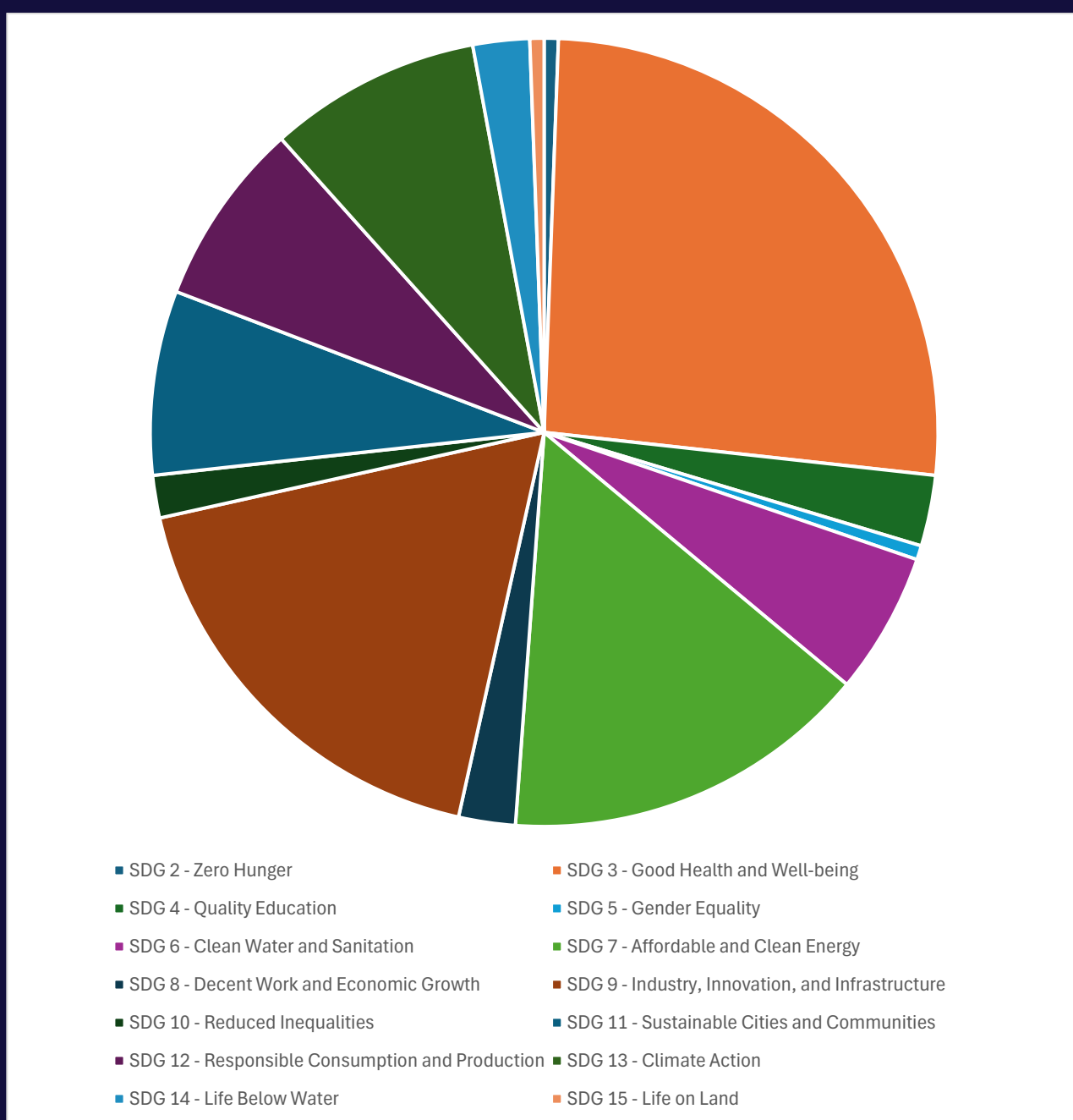
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SUSTAINABLE DEVELOPMENT GOALS

Universities and knowledge institutions have a critical role to play in the achievement of the United Nations Sustainable Development Goals (SDGs). Here is a breakdown of the Research Outputs for the School of Computing, according to their SDGs.



4. RESEARCH FUNDING

Portfolio of Research Grants awarded during period 1 August 2023 - 31 July 2024

| UoA MEMBER(S) | PROJECT TITLE | FUNDER | VALUE | AWARD DATE |
|---|--|--|----------------|------------|
| Prof. Michaela Black Prof. Liming Chen Dr Ian Cleland Prof. Jun Liu Prof. Liam Maguire Prof. Christopher Nugent Prof. Jonathan Wallace Dr Shuai Zhang | Artificial Intelligence Collaboration Centre (AICC) | Invest Northern Ireland | £13,830,161.00 | 24.08.2023 |
| Dr Susan Langdon Professor Raymond Bond | The usability of Digital Stories as a tool to help young people understand coercive behaviour | Northern Health and Social Care Trust | £5,571.83 | 05.09.2023 |
| Dr Aftab Ali Prof. Liming Chen | Sustelligence Net Zero Software - Impact UX Project | Innovate UK | £7,390.00 | 15.11.2023 |
| Dr Patrick McAllister | Second International Digital Mental Health and Wellbeing Conference 2024 | Health & Social Care R&D Division Public Health Agency | £2,500.00 | 11.12.2023 |
| Prof. Kristel Miller Prof. Jonathan Wallace | Moving the dial on economic inactivity to build inclusive futures across Northern Ireland through partnerism, innovation and co-creation | Economic & Social Research Council | £3,240,638.44 | 14.12.2023 |
| Dr Matias Garcia-Constantino | Low-cost smart home solution to support thermal comfort, health and security | NI Department for the Economy | £6,016.15 | 21.12.2023 |

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|---|--|--|---------------|------------|
| Dr Shengli Wu | New ensemble learning based approach for medical document retrieval and human activity recognition. | NI Department for the Economy | £3,000.00 | 31.01.2024 |
| Prof. Huiru Zheng | Can objective stability assessment of walking aid use outside the clinic facilitate stroke rehabilitation? | Engineering & Physical Sciences Research Council | £3,877.60 | 05.02.2024 |
| Dr Priyanka Chaurasia Prof. Sally McClean | Screen4Lead in Mothers: Automated lead toxicity prediction in pregnant women using predictive modelling | NI Department for the Economy | £13,326.68 | 09.02.2024 |
| Dr Patrick McAllister Prof. Raymond Bond | Artificial Intelligence assisted echocardiography to facilitate accurate image capture and transmission for congenital heart defects diagnosis in Sub-Saharan Africa | National Institute of Health (US) | £93,281.31 | 26.02.2024 |
| Prof. Huiru Zheng Prof. Raymond Bond Dr Ian Cleland Dr David Glass Dr Joseph Rafferty Dr Haiying Wang Prof. Jonathan Wallace | Irish Signals and Systems Conference 2024 | Visit Belfast | £6,700.00 | 20.03.2024 |
| Prof. Dewar Finlay Prof. Raymond Bond | EPSRC Centre for Doctoral Training in Digital Health Technologies | Engineering & Physical Sciences Research Council | £4,122,678.73 | 06.06.2024 |

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|---|---|--|-------------|------------|
| Dr Sonyia McFadden Prof. Raymond Bond | UKIO An analysis of User feedback of different interfaces and designs for clinically relevant decision support when using AI: What do imaging professionals prefer? | Radiation and Oncology Congresses | £5,000.00 | 10.06.2024 |
| Prof Maurice Mulvenna Prof. Raymond Bond | Discovering and understanding speech-derived vocal biomarker patterns related to mental health sciences | Canary Speech | £62,965.99 | 13.06.2024 |
| Prof. Siobhan O'Neill Prof. Raymond Bond Prof. Maurice Mulvenna | OUR Generation | EU Programme for Peace and Reconciliation in Northern Ireland and the Border Region of Ireland | £868,166.52 | 04.07.2024 |
| Dr Sarah Butter Prof. Maurice Mulvenna | Developing and Broadening Research Networks in Turkey to Support the Mental Health of Refugees and Internally Displaced Victims of Disasters | NI Department for the Economy | £14,905.00 | 29.07.2024 |
| Dr Patrick McAllister Prof. Raymond Bond Dr Jorge Martinez Carracedo | Transforming Neonatal Cardiac Diagnostics with AI: Networking and Partnership Initiative in Sao Paulo | NI Department for the Economy | £20,651.97 | 29.07.2024 |

5. NOTE FROM THE ASSOCIATE DEAN

The 2023-24 Annual Research Report for the School of Computing reflects Ulster University's ongoing commitment to delivering impactful research excellence in areas that actively contribute to the economy of Northern Ireland and to society more generally.

The scope and scale of the research undertaken by the School is reflected in the high quality of the various outputs reported here and the direct positive impact that it is having on society through our various partnerships with industry and other national and international institutions.

The University Strategy: 'People, Place and Partnership' seeks to deliver 'Sustainable Futures for All' with research and innovation central to its success ([People, Place and Partnership - People, Place and Partnership](#)). The associated University Research Strategy (2023-2028) focuses on how our core values of Collaboration, Enhancing Potential, Inclusion, and Integrity underpin a sector-leading environment for the continued development of talent and opportunity across our designated research themes ([Ulster University Research Strategy 2023-2028](#)).

“[W]e are focused on further increasing our world-leading and internationally excellent research that impacts both locally and globally[.]”

As we to plan our submissions to relevant subject areas in the 2029 UK Research Excellence Framework exercise (REF2029), we are focused on further increasing our world-leading and internationally excellent research that impacts both locally and globally with Open Research as a central tenet of our ambitions.



Professor Brian J. Meenan

Associate Dean for Research and Innovation

REF 2021



ULSTER UNIVERSITY
(REF 2021)



COMPUTER SCIENCE AND INFORMATICS
(REF 2021)



FOR RESEARCH CULTURE AND OVERALL SATISFACTION

Research Centres and Groups

Research Centres:

Pervasive Computing Research Centre (PCRC)

Advanced Research and Engineering Centre (ARC)

Innovation Centres:

BT Ireland Innovation Centre (BTIIC)

Artificial Intelligence Research Centre (AIRC)

Northern Ireland Connected Health Innovation Centre (CHIC)

