Royal Academy of Engineering

Dr Ali Mohammed Ali Hayajneh

Assistant Professor in Communication and Networking for Internet of Things (IoT), Robotics and Autonomous Systems at Hashemite University, Jordan

PROFILE
Distinguished International Associate

Thematic area: Wireless communications and artificial intelligence (AI)

Project title: Ultra-low-cost, machine-learning-enabled IoT Devices on the edge (MLEIoT)

Strategic goals: This project is working towards showcasing the capabilities of sensor node controllers in AgriTech, by enabling enhanced farming and water management practices in Jordan.

Background: After obtaining a BSc in electrical engineering and an MSc in wireless communications at Jordan University of Science and Technology, I studied a PhD in electronics and electrical engineering at the University of Leeds, with a thesis on drone-assisted wireless communications.

I returned to Jordan and spent several years working as a lecturer, teacher and trainer, before retruning to the University of Leeds in 2015 to focus on digital communications.

Previous Academy involvement: I collaborated with Dr Des McLernon at the University of Leeds on a Royal Academy of Engineering-sponsored project entitled 'Drone-assisted micro-irrigation for dry lands in Jordan based on IoT sensor networks'. The experience I had with the Academy was great, and I hope to continue working with them to develop more opportunities.

About my project

Objectives: In a country with scarce water resources, smart solutions to water management are vital, especially in the agriculture sector. Jordan is investing heavily in agriculture development and innovation, with many AgriTech startups and accelerators. However, reducing the cost of domestic solutions is proving problematic among poorer farmers.

This project aims to use edge machine-learning (ML) algorithms to address the issue of water and energy forecasting across the national water grid. The main objective is to build a good base for using ML algorithms in low-performance-edge IoT devices. This will reduce the congestion of the communication network and the capital expenditure costs of IoT infrastructure. I also hope to build collaborative links between local companies and UK researchers.

A main objective is to open new collaboration links with researchers in the UK and the local industry, and we are doing so. Visits for collaborative work are planned for next summer at the University of Leeds, where I will meet students and scholars from the universities of Leeds, Glasgow, York, and Huddersfield.

On the UK side... I'm co-supervising two PhD students at the University of Leeds, meeting them personally and giving them new ideas. In York and Glasgow, I will meet the research groups for two professors (Professor Alister Burr in the Department of Electronic Engineering at the University of York, and Muhammad Ali Imran, Professor of Communication Systems at the University of Glasgow) to discuss how we can collaborate in problem-solving.

Project output: By the time the project is completed, I will have designed the project website and populated it with all the appropriate data. I will do a collaborative extended literature study

to define all the aspects that will allow enabling ML on the edge of IoT devices, contacting Jordanian startups to identify the problems they have. This will lead to a draft review paper and make an online seminar for students and colleagues to densify their understanding, while I will choose students to run experiments as their graduation projects.

There will be conference and journal papers, plus a website showing the long-term results of the cooperation between the Universities of York, Leeds, Glasgow, and the Hashemite University. Iaceer and Smart Eye will be my industry startup partners. I'll hold free workshops that gather expertise from both industry and academia, building mutual research channels with all partners. Key project results (source codes, PCB schematics and data) will be open for developers and researchers on GitHub, subject to intellectual property rights.

Anticipated outcomes and impact: In terms of AgriTech, the project will make the use of ML-enabled edge IoT sensors more affordable, increasing the adoption of data-driven farming. It will improve and increase the research capacity of startups, spotlighting the benefits of using ML-enabled edge devices.

This project will create an application-oriented society of researchers, focusing on AgriTech applications.

Crucially, it will benefit smaller and poorer farmers throughout Jordan – and potentially elsewhere in the world – by making the benefits of smart water management more accessible across their land.

Final thoughts on the Distinguished International Associates programme: The links that we created and the opportunities that we opened are long lasting. The project has opened opportunities for me to expand my network with academics and engineers from international and local universities and industries. The sub-projects, workshops and products that relate to the project gave me some visibility and helped me to be selected as the director of the innovation and entrepreneurial projects centre at Hashemite University.

About the Distinguished International Associates Programme

The Distinguished International Associates Programme is an award scheme for international engineers working across all sectors, who are at the cutting edge of engineering research or innovation.

Awardees are offered a grant to amplify the impact of an existing collaboration with the UK in an area that aligns with the Academy's new strategic priority themes.

The programme aims to develop a broad international network of excellent diverse engineers across countries and disciplines, with research and innovation links to the UK, to work alongside the Academy to enhance progress towards achieving its goals for an inclusive economy and sustainable society.