

AMNA ALNIMR ALZAROONI

Laboratory Engineer | Researcher in AI-Enabled HVAC, Smart Buildings & Energy Systems | Innovation Hub Technical Contributor

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PROFESSIONAL PROFILE

Laboratory Engineer and engineering researcher at the University of Sharjah, specialising in intelligent HVAC systems and building energy management, with a focus on HVAC operation, maintenance and fault detection and diagnostics (FDD), predictive maintenance and smart building technologies. Research combines Digital Twins, IoT-enabled BEMS, machine learning, Large Language Models (LLMs) and Agentic AI for building operation and engineering decision support. Experienced in laboratory engineering, renewable and sustainable energy systems, experimental validation and engineering education. Selected to contribute technical and operational expertise to the University of Sharjah Innovation Hub.

Areas of Specialisation: HVAC Systems & Maintenance | Building Energy Management | Fault Detection & Diagnostics (FDD) | Predictive Maintenance | Smart Buildings | BMS/BEMS | Digital Twins | IoT | Machine Learning | Energy Optimisation | Large Language Models (LLMs) | Agentic AI | Multi-Agent Systems

1. EDUCATION

Doctor of Philosophy (Ph.D.) in Engineering Management Sep 2023 – Jun 2027 (expected)

University of Sharjah, Sharjah, United Arab Emirates

Standing: Excellent.

Dissertation: Digital-twin and artificial-intelligence-based energy management in buildings for the reduction of energy waste and the enhancement of HVAC efficiency within an Industry 4.0 framework.

Research focus: Digital Twin and AI-enabled building energy management — HVAC efficiency, energy-waste reduction, predictive analytics, diagnostics and intelligent decision support within an Industry 4.0 framework.

Supervisory context: Department of Industrial Engineering and Engineering Management.

Professional Diploma in Artificial Intelligence Jul 2024 – Sep 2024

University of Sharjah, Sharjah, United Arab Emirates

Master of Science (M.Sc.) in Engineering Management Sep 2020 – Jan 2023

University of Sharjah, Sharjah, United Arab Emirates

Thesis: Optimisation of waste management and the supply chain for fresh food — conversion of food waste to methane through mixture optimisation for enhanced production.

Bachelor of Science (B.Sc.) in Sustainable and Renewable Energy Engineering Jan 2015 – Jun 2019

University of Sharjah, Sharjah, United Arab Emirates

Graduation project: Design and performance evaluation of an evacuated-tube solar collector employing nanofluids for heating applications.

2. ACADEMIC APPOINTMENTS

Engineer (Laboratory Engineering & Research) Mar 2025 – Present

Department of Sustainable and Renewable Energy Engineering, University of Sharjah — Full-time

- Technical management and operation of the teaching and research laboratories of the Sustainable and Renewable Energy Engineering programme.
- Laboratory equipment procurement, commissioning, calibration, troubleshooting, preventive maintenance and technical support.
- Preparation, testing and validation of experimental systems and laboratory set-ups; laboratory safety compliance, equipment reliability and operational readiness.
- Experimental data acquisition, engineering analysis and technical documentation.
- Technical support for faculty research in renewable and solar energy systems, thermal and building energy (HVAC) systems, and IoT-based monitoring and AI-enabled energy-management applications.
- Supervision of undergraduate students during laboratory sessions, including the Solar Photovoltaic Laboratory (course 0406321).

Research and Teaching Assistant Aug 2019 – Nov 2024

College of Engineering, University of Sharjah — Part-time

- Biomass and Environmental Research Group (2020–2024): waste-to-energy conversion and process optimisation.

- Energy Storage Research Group: energy management, artificial-intelligence integration, nanotechnology and solar energy applications.
- Laboratory instruction across heat transfer, materials, manufacturing, energy storage, photovoltaics and biomass.
- Supervision, mentoring and assessment of Senior Design Project (SDP) teams.

3. INSTITUTIONAL INNOVATION & TECHNICAL CONTRIBUTIONS

Selected Technical Contributor — University of Sharjah Innovation Hub

2026 – Present

University of Sharjah — institutional selection, held alongside the primary appointment above

- Selected by the University of Sharjah, among laboratory and technical staff, to contribute specialised technical and operational expertise to Innovation Hub activities.
- Support for interdisciplinary innovation and technology-development activities within the area of engineering specialisation.

4. RESEARCH AREAS

- Smart building energy management and intelligent HVAC systems.
- HVAC operation, energy efficiency and performance optimisation.
- HVAC fault detection and diagnostics (FDD), anomaly detection and condition monitoring.
- Predictive and condition-based maintenance of HVAC and building energy assets.
- Digital twins and cyber-physical systems for smart buildings and energy assets.
- Building management systems (BMS/BEMS), Internet of Things (IoT) sensing and real-time building monitoring.
- Artificial intelligence and machine learning for energy-demand forecasting, diagnostics and optimisation.
- Large language models (LLMs) for engineering knowledge, building analytics and decision support.
- Agentic AI and multi-agent systems for human-in-the-loop building management.
- Occupancy-aware HVAC operation and intelligent control strategies.
- Metaheuristic and multi-objective optimisation of building and energy systems: genetic algorithms, particle swarm optimisation, reinforcement learning, design of experiments.
- Solar photovoltaic and solar thermal system design, modelling and performance evaluation; energy storage and hybrid renewable energy systems.
- Biomass and waste-to-energy conversion; circular economy and life-cycle assessment.
- Industry 4.0, engineering management and sustainable operations.

5. RESEARCH PROJECTS AND INSTITUTIONAL COLLABORATIONS

AI-Enabled Digital Twin for Smart Building Energy and HVAC Management

Ongoing

University of Sharjah — pilot implementation in Building W9 teaching spaces

Development and validation of an IoT- and Digital-Twin-enabled building energy management framework integrating real-time sensing, HVAC energy monitoring, predictive modelling, fault diagnostics, predictive maintenance and AI-enabled decision support for university buildings.

- Integration of BMS exports, IoT indoor-environment sensors (temperature, humidity, CO₂, particulate matter, occupancy), HVAC energy metering and weather data through Home Assistant, InfluxDB and Grafana.
- Python-based machine-learning pipelines for energy forecasting and diagnostics, and standards-based assessment of thermal comfort, indoor air quality and HVAC energy performance (ASHRAE 55, ASHRAE 62.1, ISO 7730).
- Agentic AI decision-support layer in which a grounded LLM works with deterministic analytics and guardrails to produce engineer-approval-ready recommendations under human-in-the-loop governance.
- Interdisciplinary collaboration with Industrial Engineering and Engineering Management, Computing and Informatics, and Facilities Management and Planning (University of Sharjah), and the University of Dubai.

Waste Management Strategies in Food Manufacturing (2022) — Sharjah Cooperative Society. Optimisation of waste management and of the fresh-food supply chain.

Project Management and Governance Collaboration (2021) — Dubai Police Headquarters. Project management, governance and operations.

Renewable Energy Research Traineeship (2021) — International Renewable Energy Agency (IRENA).

6. PUBLICATIONS AND MANUSCRIPTS

Conference papers (accepted; proceedings forthcoming)

- [C1] **Alzarooni, A.**, et al. “An Agentic AI-Enabled Building Management System for Occupancy-Aware HVAC Operation, Fault Detection, and Predictive Maintenance.” *ACS/IEEE International Conference on Computer Systems and Applications (AICCSA 2026)*. Accepted.

- [C2] **Alzarooni, A.**, et al. “Digital Twin-Enabled Smart Building Management Using IoT Sensors and Home Assistant: A University of Sharjah Case Study.” *AgenTwin-IoT’26 Workshop, co-located with AICCSA 2026*. Accepted.

Journal manuscripts in preparation

- [J1] **Alzarooni, A.**, Masmoudi, M., Oulefki, A., Saifae, S., Bounceur, A., Ghenai, C., Alouane, A. H. “From measured HVAC behaviour to engineer-approval-ready decisions: an agentic AI-enabled Digital Twin BEMS with deterministic guardrails.” In preparation for submission to *Energy and Buildings*.
- [J2] **Alzarooni, A.**, Masmoudi, M., Ghenai, C., Alouane, A. H. “Optimization and Artificial Intelligence for HVAC-Centric Building Energy Management: A Systematic Review of Control, Diagnostics, and Energy Coordination.” In preparation for submission to *Energy and Buildings*.

Manuscripts and preprints are available upon request.

7. TECHNICAL COMPETENCIES

HVAC and building energy systems — HVAC performance analysis; building energy management and monitoring; BMS/BEMS; thermal systems; HVAC energy optimisation; occupancy-aware operation; standards-based assessment of thermal comfort, indoor air quality and energy performance (ASHRAE 55, ASHRAE 62.1, ISO 7730, ISO 50006).

Maintenance, diagnostics and asset performance — Fault detection and diagnostics (FDD); anomaly detection; condition monitoring; predictive maintenance; equipment performance assessment; laboratory equipment calibration, troubleshooting and maintenance.

Artificial intelligence and machine learning — Predictive modelling and forecasting; regression and classification; neural networks; reinforcement learning; AI-enabled decision support.

Large language models and agentic AI — Application of LLMs to engineering and building-operation decision support; grounded LLM reasoning combined with deterministic analytics and guardrails; agentic AI and multi-agent system architectures; human-in-the-loop AI workflows.

Digital twins, IoT and smart buildings — Digital-twin modelling of buildings and energy systems; cyber-physical systems; IoT sensing and real-time monitoring; BMS/BEMS integration; Home Assistant, InfluxDB, Grafana, n8n; Industry 4.0 frameworks; smart building analytics.

Programming and data analytics — Python (Jupyter, Google Colab), MATLAB/Simulink, C++, Maple, Excel and Excel Solver, Power BI, PSPICE; data analysis and visualisation.

Optimisation — Genetic algorithms, particle swarm optimisation, multi-objective and mixture optimisation, design of experiments (DOE), Lean and Six Sigma methods.

Energy system simulation and design — TRNSYS, System Advisor Model (SAM), PVsyst, CFD, AutoCAD; photovoltaic sizing and yield modelling, solar thermal collector design, energy storage sizing, energy audits and techno-economic analysis.

Engineering and operations management — Project management, total quality management, feasibility studies, life-cycle assessment, supply chain and waste-management optimisation.

Experimental competence — Photovoltaic and DSSC fabrication and testing, nanofluid characterisation, heat transfer and thermal systems, energy storage testing, biomass and environmental analysis.

8. TEACHING AND LABORATORY INSTRUCTION

Solar Photovoltaic Laboratory (course 0406321)	2017 – Present
Biomass and Environmental Laboratory	2022 – 2024
Computing and Programming Laboratories (C++, MATLAB/Simulink, PSPICE)	2016 – 2024
Manufacturing and Mechanical Laboratory	2019 – 2023
Heat Transfer Laboratory	2017 – 2023
Materials and Chemistry Laboratory	2018 – 2022
Energy Storage Laboratory	2019 – 2022
Applied Electronics, Circuits and Electric Power Laboratories	2017 – 2018

Selected instructional responsibilities

- Fabrication and testing of dye-sensitised solar cells (DSSCs); instruction in photovoltaic system installation and in the assessment of temperature and shading effects.
- Heat-exchanger experimentation on conduction, convection and radiation, and thermal system optimisation.
- Investigation of sustainable nanofluids (Al_2O_3 , TiO_2 , MWCNT) and their influence on thermal conductivity and system performance.
- Instruction on batteries, supercapacitors, fuel cells and thermal energy storage, with data analysis in MATLAB and Excel Solver.
- Supervision of experiments on the conversion of food waste to energy through biomass production and process optimisation.

- Supervision of prototype development for automated machines powered by renewable energy.

9. PROFESSIONAL EXPERIENCE

Assistant Manager, Operations	Jul 2022 – Dec 2024
<i>Al Ansari Exchange, United Arab Emirates — Full-time</i>	
• Supervision and training of operational teams; project management, marketing initiatives and customer relations. • Application of compliance and anti-money-laundering procedures in accordance with Central Bank regulations.	
Assistant Project Engineer	Aug 2021 – May 2022
<i>Dubai Police, United Arab Emirates — Contract</i>	
• Support to the Project Management Department in project governance, planning and operational coordination.	
Researcher	Mar 2021 – Oct 2021
<i>International Renewable Energy Agency (IRENA) — Contract</i>	
• Research on renewable energy deployment, including technology and policy assessment.	
Safety Engineer (Internship)	Jun 2020 – Dec 2020
<i>Sharjah Prevention and Safety Authority, United Arab Emirates</i>	
• Participation in safety and security engineering assessments and inspection procedures.	
Project Engineer	May 2019 – Feb 2020
<i>Sharjah International Airport, Sharjah, United Arab Emirates — Contract</i>	
• Support to electrical and facility engineering projects, including planning and site coordination.	
Energy Engineer (Internship)	Jan 2019 – Apr 2019
<i>Sharjah Electricity, Water and Gas Authority (SEWA), United Arab Emirates</i>	
• Assistance in energy management and engineering-management activities within utility operations.	

10. CERTIFICATIONS AND PROFESSIONAL DEVELOPMENT

Professional Diploma in Artificial Intelligence, University of Sharjah	2024
Advanced Anti-Money Laundering Training, Central Bank of the UAE	2022
Project Management Professional (PMP), University of Sharjah	2021
Certified Project Planner, University of Sharjah	2021
International Computer Driving Licence (ICDL), University of Sharjah	2019

11. LANGUAGES

Arabic — Native; full academic and professional proficiency.

English — Full academic and professional proficiency.

12. REFERENCES

Engineering Management

Prof. Atidel Aboubaker Ep Ben Hadj Alouane — Chair, Department of Industrial Engineering and Engineering Management, University of Sharjah. Email: aalouane@sharjah.ac.ae

Prof. Fikri T. Dweiri — Professor and Programme Coordinator, Doctorate Programme, University of Sharjah. Email: fdweiri@sharjah.ac.ae

Dr. Malek Masmoudi — Associate Professor, University of Sharjah. Email: mmasmoudi@sharjah.ac.ae

Sustainable and Renewable Energy

Prof. Chaouki Ghenai — Professor and Chairman, Research Funding Department, College of Engineering, University of Sharjah. Email: cghenai@sharjah.ac.ae

Dr. Abrar Inayat — Associate Professor, College of Engineering, University of Sharjah. Email: ainayat@sharjah.ac.ae

Dr. Ali Mohammed Radwan — Associate Professor, College of Engineering, University of Sharjah. Email: ali.radwan@sharjah.ac.ae

Dr. Zafar Said — Associate Professor, College of Engineering, University of Sharjah. Email: zsaid@sharjah.ac.ae

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