

Portfolio Summary

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AI at the Edge and IIOT Environments - ITAI 3377

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Module 1: Introduction & AI Tools

- A01: Explored ChatGPT and GitHub Copilot in coding tasks.
- Reflected on AI-assisted programming and creativity in prompt design.
- Key Takeaway: Generative AI can enhance developer productivity when used with intention.

Module 2: Model Conversion & Edge Tools

- L02a/b & A02: Converted models to TensorFlow Lite for edge deployment.
- Learned TFLite advantages: size, speed, on-device AI capability.
- Compared TFLite to standard TensorFlow models in size and speed.
- Key Takeaway: Optimized models enable real-time AI inference on low-power edge devices.

Module 3: Edge Deployment Simulation

- L03 & A03: Simulated edge AI deployment in smart city use cases.
- Tools: Edge Impulse Studio, focus on low-latency inference.
- Focused on low-latency inference and real-time decision-making.
- Key Takeaway: Deploying on the edge reduces cloud dependency and enhances responsiveness.

Module 4: IIoT Protocols & Network Design

- A04 & L04: Implemented MQTT, CoAP, and OPC UA in sensor simulations.
- Designed a conceptual IIoT network for real-time monitoring.
- Key Takeaway: Protocol selection impacts interoperability and system scalability.

Module 6: Time-Series Forecasting

- L06 & A06: Forecasted temperature using TimeGPT + VAE for synthetic data.
- Achieved improved accuracy: MAE dropped from 3.72 to 3.55.
- Key Takeaway: Combining generative models with forecasting boosts prediction reliability.

Module 7: Aol vs Reliability in IIoT

- L07: Modeled Age of Information (Aol) using Random Forest.
- Analyzed the impact of packet loss and transmission probability.
- Key Takeaway: Network quality and traffic type significantly affect information freshness.

Module 9: RL in Industry 4.0

- A09: Case study on reinforcement learning for autonomous AGVs.
- Learned benefits of decentralized control and Q-learning algorithms.
- Learned Q-learning within multi-agent decentralized systems.
- Key Takeaway: RL enables adaptive, autonomous behavior in dynamic industrial environments.

Midterm Project: Cybersecurity Plan

- Designed a defense-in-depth strategy for healthcare IIoT system.
- Covered device/network/AI vulnerabilities and mitigation tactics.
- Proposed layered defense across devices, AI, and data.
- Key Takeaway: Proactive, multi-layered security ensures trust in AI-integrated healthcare systems.

Capstone: Energy Monitoring System

- Proposed a hybrid edge-cloud AI system for building energy efficiency.
- Used Isolation Forest + PPO RL, achieving ROI > 300%, 150+ tons CO₂ saved/year.
- Key Takeaway: Smart energy systems blend AI efficiency with sustainability at scale.

Reflection & Skills Gained

- Strengthened skills in edge AI and generative models.
- Learned edge AI deployment, protocol integration, and cybersecurity planning.
- Built forecasting and anomaly detection models using real-world tools.
- Key Takeaway: Equipped to design, deploy, and secure intelligent industrial systems.