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Assignment Report: Synthesis of AIoT Performance and Security Literature

Student Name: Abdulaziz Saleh Mohammed Alhasil

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Summary research paper's:

Paper 1: "AI-Driven Quality Control in Manufacturing and Construction: Enhancing Precision and Reducing Human Error"

This paper looks at how Artificial Intelligence's changing quality control. The people who wrote this paper show how computer vision and machine learning can help reduce mistakes made by people. Their research says that Artificial Intelligence systems can find errors at a cost and fix problems more efficiently than people can. Their research indicates that Artificial Intelligence systems perform error recognition at a lower cost and preemptively resolve issues more efficiently than human workers.

Paper 2: "From IoT to AIoT: Evolving Agricultural Systems Through Intelligent Connectivity in Low-Income Countries"

This paper studies the transformation of agriculture from the use of the Internet of Things to the Artificial Intelligence of Things. The authors advocate for the implementation of "Edge AI" which assists in the optimization of food production, and the judicious use of water and fertilizers in resource-deficient environments.

Paper 3: "AI-Powered IoT: Transforming Healthcare and Smart Infrastructure "

This paper analyses the impact of the AIoT evolution on different industries. The researcher notes the advancements in predictive medicine and smart city management, while also listing the challenges of data privacy and interoperability as the most significant challenges of this evolution.

Paper 4: " Artificial Intelligence and the IoT: Transforming Connectivity "

This paper examines the AI and IoT merger on a technical level. The researcher describes specific AI algorithms (Machine Learning, Deep Learning, and Reinforcement Learning) and describes how these frameworks help smart systems operate autonomously and more efficiently.

Paper 5: " Trustworthy Adaptive AI for Real-Time Intrusion Detection "

This research presents a model of a reliable responsive AI for real-time intrusion detection for Industrial Internet of Things (IIoT). Using a recent cyberattack dataset, the authors achieved a detection accuracy of 99.2% with a rapid, damage-prevention response.

Paper 6: " Ecological footprints and energy transitions: impact of AI "

The research is a study that was done in 67 countries. This study was done to see what the impact of Artificial Intelligence is on the ecosystem. The study found that Artificial Intelligence helps manage resources and energy in a way. This helps reduce the amount of things we put into the air and helps us move to resources that are good for the earth. The research shows that Artificial Intelligence is good, for the ecosystem because it helps us use resources and energy in a way.

Critical Analysis:

The strengths and weaknesses of incorporating Artificial Intelligence with the Internet of Things (AIoT) have been analyzed comprehensively and methodically in the provided literature. The research takes a multi-dimensional view to formulate the efficiency, security and sustainability of AIoT using performance evaluations from multi-dimensional experiments, bespoke algorithms, and complex machine learning systems. Research gaps that deal with the security of the Industrial Internet of Things (IIoT) and environmental sustainability seem to be more practical with their approaches to scalability. The drawbacks include the considerable computational burden of some adaptive AI systems, sectoral and single-focused scope limitations, and excessive dependence on computationally expensive hardware. Furthermore, some literature mentions very little about the “interoperability” standards of devices and lacks a comparative study with other methodologies. Big data analysis and simulations used to evaluate performance in the presented methodology make sense, but more information about the fine-tuning of algorithm parameters would be appreciated scientifically. Although the research has a substantial contribution to the AIoT systems, dealing with resource depletion and finding better solutions to comparative research is still a considerable challenge.

Connections:

- * **Focus on AI and IoT Integration:** All research papers address a core theme: transforming the Internet of Things from a mere data collection network into intelligent systems (AIoT) capable of decision-making.
- * **Automation of Decision-Making:** Several studies share a discussion on the "autonomous" capability of devices, illustrating that this is the future trend for reducing human intervention.
- * **Optimization and Resource Efficiency:** There is a unified goal among researchers focusing on using AI to optimize resource utilization, whether in energy, agricultural water usage, or carbon emission reduction.
- * **Performance Evaluation:** Most papers include empirical analysis or performance evaluations using real-world datasets or statistical models to validate proposed solutions.
- * **Need for Lightweight Solutions:** Due to the resource constraints of IoT devices, several studies emphasize the necessity of developing AI models that do not consume excessive power.

Conflicts between the findings:

- * **Edge vs. Cloud Processing:** While some studies support data processing at the "Edge" to reduce latency, others suggest relying on Cloud computing to handle massive and complex data.
- * **Learning Techniques:** Discrepancies appear in the choice of algorithms; some papers rely on "Traditional Machine Learning" for ease of implementation, while others insist on using "Deep Learning" and "Adaptive Learning" despite their high resource consumption.
- * **Comprehensive vs. Specialized Security:** While some articles focus exclusively on "Intrusion Detection," others attempt to address data security and privacy as part of an integrated system encompassing infrastructure and protocols.
- * **Applicability in Developing Nations:** There is a clear conflict between research proposing high-cost, complex solutions and studies emphasizing the need for solutions applicable in "low-income countries" with weak infrastructure.
- * **Sectoral Focus vs. Universality:** Some research proposes solutions tailored to a single sector (such as agriculture or healthcare only), while others attempt to provide a "General Framework" suitable for all smart city applications, raising questions about the effectiveness of general solutions in specialized environments.

Synthesis Matrix for Literature Review:

study	Research Design	Key Findings/Results	Methodology	Limitations
AI-Driven Quality Control in Manufacturing and Construction (Hasan et al., 2025)	Synthesis	- Human error has been minimized on complex and difficult production lines. - Maintenance and operating costs have been reduced by 40%. - Very high accuracy, approaching 100%, in detecting microscopic defects.	• Multi-dimensional synthesis review of over 120 industrial reports. • Big Data analytics from steel production sites worldwide. • Benchmarking of CNNs versus historical human inspection records. • ROI analysis of predictive vs reactive maintenance cycles. • Computer vision and BIM models integration study. • Synthesis of precision metrics of AOI diagnostics.	• Extremely high initial costs. • Small business implementations are highly challenging. • Data security is often ignored.
From IoT to AIoT: Evolving Agricultural Systems (Kasereka et al., 2026)	Systematic	- Research helps enhance food security in developing and rural areas. - More than 60% of network bandwidth has been saved. - Irrigation efficiency and fertilizer distribution have been improved by over 25%.	• PRISMA guidelines followed for systematized literature review. • Findings from 150 studies on low-income countries synthesized. • Resilience studies on LoRa WAN rural signal propagation. • Feasibility study on autonomous irrigation powered by solar energy. • SVM and Random Forest's memory footprint classification. • Correlation research on AI and water savings.	• Complete reliance on stable electricity. • Equipment maintenance is difficult in extreme conditions. • Farmers have little technical knowledge.

			• Assessing Edge Intelligence impact on cloud response time.	
AI-Powered IoT: Transforming Healthcare and Smart Infrastructure (Areej Mustafa, 2025)	Exploratory	- Ways have been found to remotely monitor the health of the elderly. - Traffic flow in smart cities has been improved by 15%. - Emergency medical responses have been significantly and effectively reduced.	• Exploratory research design for cross-sectoral AIoT stacks. • Study on “Distributed AI” for better processing speed. • Study on encryption issues in hybrid edge integrated paragon. • Case studies analysis on remote patient monitoring. • Review on HL7 and FHIR interoperability. • SWOT analysis on autonomous traffic management. • 5G/6G forecasting on the socio-economics of the built environment.	• No testing in laboratories. • No practical solutions for interoperability. • Little research is done on the experimental quantitative fronts.
Artificial Intelligence and the IoT: Transforming Connectivity (Hadia Azmat, 2024)	Descriptive	- Devices transformed into fully autonomous smart agents - Smart home reliability and efficiency improved by 20% - Optimal energy management has been achieved. Battery life improved through reinforcement learning	• AI-IoT intersection mapping in the descriptive/analytical mode. • Functional utility classification of ML, DL, and RL. • Assessment of the shift from MQTT to AI augmented protocols. • Trade-off analysis of clock speeds versus inference accuracy. - Evaluation of AI logic embedding into diverse network layers.	• Communication security is often ignored. • No practical solutions exist for big data compression. • Algorithmic programming is excessively complex.

			• Investigation of RL in dynamic spectrum management.	
Trustworthy Adaptive AI for Real-Time Intrusion Detection (Al Rawajbeh et al., 2025)	Experimental	- Random or false notifications and alerts reduced - Cyberattack detection with over 99% accuracy - Very fast response time, less than 10 milliseconds	• Experimental study with empirical laboratory testing cycles. • Leveraging the standardized Edge-IIoTset for validation. • Head-to-head benchmarking of XGBoost, RF, and KNN. • Simulation of industrial network topologies under stress. • Measuring performance using F1-score and ROC-AUC curves. • Evaluation of energy consumption vs. detection accuracy.	• CPU load is high. • Legacy systems are challenging to implement. • Systems require ongoing retraining on new data.
Ecological footprints and energy transitions: impact of AI (Wang et al., 2024)	Quantitative	- Supports developed countries for urban greening - A direct correlation was found between carbon reduction and the development of artificial intelligence - Global energy efficiency improved by over 12% annually	Quantitative analysis via econometric panel data modeling. • Utilization of SYS-GMM to ensure statistical consistency. • Analysis of 20 years of longitudinal data (67 nations). • Integration of trade openness and urban density variables. • Evaluation of R&D roles in carbon reduction acceleration. • Calculation of "Green Transition Coefficients" for energy grids.	• Systems are designed with macroeconomics as the sole focus. • Systems fail to consider the effects of equipment manufacturing on the environment. • Systems are inadequate in unstable countries.

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