

EDGE AI: REVOLUTIONIZING INDUSTRIAL AUTOMATION IN MANUFACTURING, AUTOMOTIVE, AND PLANT OPERATIONS

Enhancing real-time decision-making, security, and efficiency with AI at the edge.



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Abstract

Edge AI merges artificial intelligence (AI) with edge computing to process data in real-time, closer to its source. This eliminates cloud dependency, reduces latency, enhances security, and improves operational efficiency. Industries such as manufacturing, automotive, and plant operations are leveraging Edge AI for predictive maintenance, autonomous robotics, and AI-driven supply chain optimization. This whitepaper examines the key drivers, challenges, and real-world applications of Edge AI, providing insights into its role in industrial automation.

Introduction

The convergence of AI, IoT, and edge computing has unlocked new opportunities for real-time decision-making. Traditional cloud AI solutions face high latency, bandwidth constraints, and security risks. Edge AI solves these challenges by deploying AI algorithms directly on edge devices, empowering industries with enhanced predictive maintenance, streamlined production, and optimized logistics. This paper explores the transformative impact of Edge AI on industrial automation.



Challenges of Cloud AI | Why the Shift to Edge is Inevitable

Industries relying on traditional AI and cloud computing face several limitations:



Latency Issues

Cloud-based AI introduces delays that impact real-time decision-making.



Security Risks

Transmitting sensitive data to the cloud increases cybersecurity vulnerabilities.



Bandwidth Constraints

High data transmission costs reduce processing efficiency.



Regulatory Compliance

Regulations (e.g., GDPR, CCPA) require local data processing.



Unreliable Connectivity

Remote industrial environments often lack stable network access.

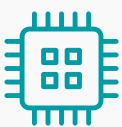
Edge AI addresses these challenges by enabling decentralized intelligence.



Edge AI | A Smarter Approach to Industrial AI Processing

Edge AI integrates AI processing capabilities into local edge devices, minimizing cloud reliance. For instance, in the automotive sector, Edge AI enables real-time pedestrian detection and collision avoidance, reducing response time by up to 50% compared to cloud-dependent systems. A study by the IEEE highlights that Edge AI processing can cut decision latency in autonomous vehicles by half, significantly enhancing safety and operational efficiency.

Key components include:



AI-Optimized Hardware:

Edge GPUs, TPUs, and NPUs enhance on-device AI capabilities.



Efficient AI Models:

Lightweight deep learning algorithms for real-time processing.



5G and Network Advancements:

High-speed, low-latency communication to support Edge AI.



Secure Data Processing:

On-device computing ensures security and compliance.



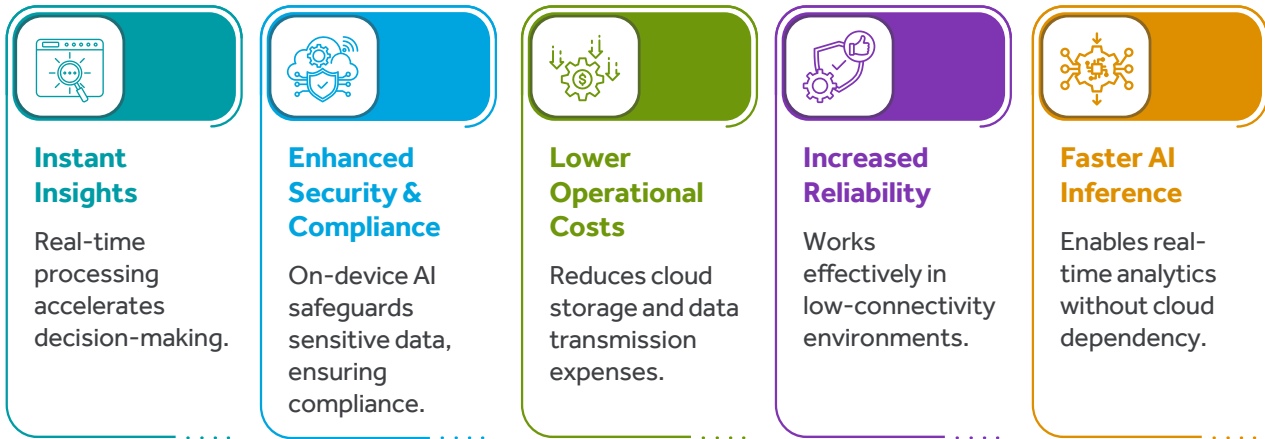
Edge AI vs. Cloud AI | A Comparative Analysis

Feature	Edge AI	Cloud AI
Processing Location	On-device, near the data source	Centralized, remote servers
Latency	Low latency, real-time processing	Higher latency due to data transmission
Security	Improved security, data stays on-site	Increased vulnerability due to cloud exposure
Bandwidth Usage	Lower bandwidth, as less data is transmitted	Higher bandwidth needed for cloud communication
Scalability	Limited by edge device capacity	High scalability with cloud resources
Reliability	Works even in low-connectivity environments	Requires stable internet

This comparison highlights why industries with real-time processing needs, security concerns, and bandwidth limitations increasingly prefer Edge AI over Cloud AI.



Edge AI in Action | Business Advantages and Best Practices



Industry-Specific Use Cases of Edge AI

Manufacturing



- **Predictive Maintenance:** AI-driven failure prediction minimizes downtime and optimizes equipment performance.
- **Automated Quality Control:** Real-time defect detection enhances product consistency and reduces waste.
- **Supply Chain Optimization:** AI-powered demand forecasting improves logistics and inventory management.

Automotive



- **Autonomous Driving Assistance (ADAS):** Real-time object detection enhances vehicle safety.
- **Driver Monitoring Systems:** AI detects fatigue and distraction for accident prevention.
- **Predictive Vehicle Maintenance:** AI anticipates mechanical failures before they occur, reducing breakdown risks.

Plant Operations



- **Energy Efficiency Monitoring:** AI optimizes power consumption and reduces energy waste.
- **Substation Automation:** AI-powered monitoring improves electrical grid stability and reduces failures.
- **Fault Detection:** Edge AI detects system anomalies in real time, preventing costly disruptions.

Success Stories

Real-World Implementations

Edge AI in Digital Imaging

Business Challenge:

A Japanese multinational struggled with QR code recognition due to poor lighting and damaged codes.

Proposed Solution:

Cyient implemented Edge AI-based image processing for real-time QR detection and decoding. We developed and deployed AI models on edge devices like the Raspberry Pi AI Camera, enabling it to host a quantized model and instantly detect QR codes with enhanced accuracy. This enabled the company to efficiently label, train, and deploy custom AI models for the camera with minimal coding experience.

Business Impact:

- **Improved Recognition Accuracy:** Reliable scanning under diverse conditions.
- **Reduced Processing Time:** Eliminated cloud dependency for faster results. The turnaround time for QR code detection improved by up to 20% to 30%.
- **Optimized Workflows:** Multiple QR codes detected in a single scan, improving operational efficiency.



Conclusion

Edge AI is transforming industrial automation by faster, more secure, and cost-efficient AI applications. Organizations implementing Edge AI benefit from enhanced efficiency, real-time analytics, and greater compliance. As AI hardware advances and 5G connectivity expands, Edge AI adoption will accelerate, reshaping industrial intelligence.

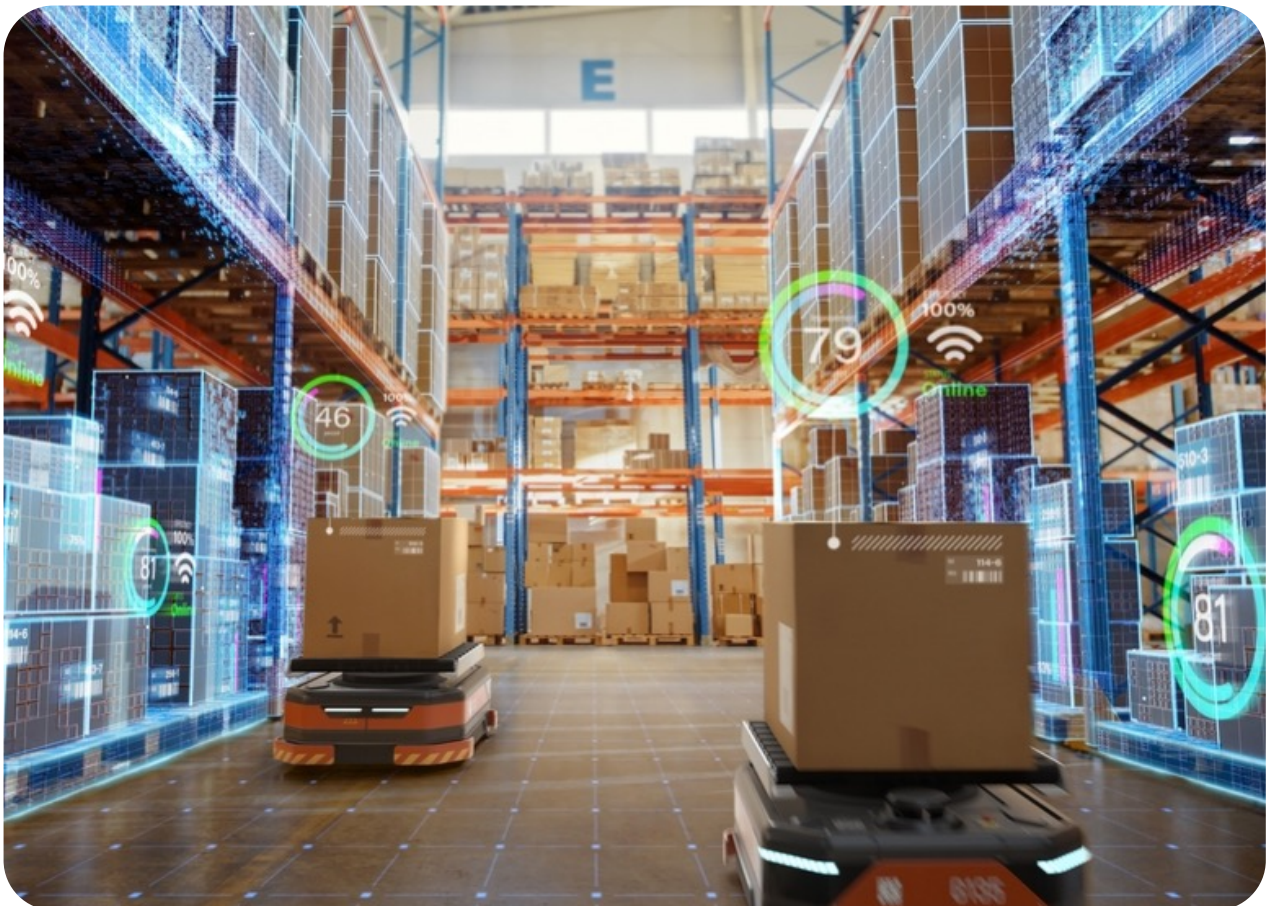
About the Author



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Chandan is an expert in Digital domain specifically AI and industrial automation with extensive experience in designing and deploying Edge AI solutions across industries. Passionate about innovation, he specializes in integrating AI, IoT, and edge computing to enhance operational efficiency and intelligence in industrial settings.



About Cyient

Cyient (Estd: 1991, NSE: CYIENT) delivers intelligent engineering solutions across products, plants, and networks for over 300 global customers, including 30% of the top 100 global innovators. As a company, Cyient is committed to designing a culturally inclusive, socially responsible, and environmentally sustainable tomorrow together with our stakeholders.

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