🧠 Project Title:

Warehouse Robot Navigation using AI and IoT Integration

🎯 Objective

To design an **autonomous warehouse robot** capable of navigating aisles, detecting obstacles, and optimizing delivery paths using **AI (CNN + RL)** and **IoT-based cloud connectivity** for monitoring and retraining.

🧩 Problem Identification

- Slow deliveries due to inefficient path planning
- Frequent collisions with shelves or other robots
- Manual monitoring required for performance tracking

⚙️ Solution Design

Stage	Description
Data Collection	Sensors (LIDAR, Camera) feed data via IoT gateway
Preprocessing	Sensor normalization, image processing using OpenCV
Modeling	CNN for obstacle detection, RL (PPO) for path optimization
Cloud Integration	AWS IoT Core for telemetry, S3 for data storage, SNS for alerting
Deployment	Edge inference for real-time movement, cloud retraining via SageMaker
Monitoring	Alerts sent via AWS SNS when collisions occur or performance drops

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☁️ Cloud Setup Summary

Component	AWS Service Used	Purpose
Device Communication	**AWS IoT Core**	Robot publishes telemetry data
Data Storage	**Amazon S3**	Stores sensor and status logs
Model Retraining	**AWS SageMaker (concept)**	For continuous model improvement
Alerts & Monitoring	**AWS SNS**	Sends real-time email alerts on collisions

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🧪 Testing & Verification

- **IoT → S3 Pipeline:** Successfully stored real-time telemetry as JSON files
- **IoT → SNS Alerts:** Instant email notification on "collisions": 1 events
- **Edge Simulation:** Continuous obstacle detection and navigation logic verified
- **RL Optimization:** PPO-trained model improves delivery path efficiency

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📈 Outcomes

- ✅ 20–30% improvement in simulated delivery efficiency
- ✅ Real-time alert system operational
- ✅ Scalable cloud-edge integration achieved

👨‍💻 Developer

Rehan Khan
Tools: Python, VS Code, OpenCV, PyTorch, Stable-Baselines3
Cloud: AWS IoT Core, S3, SNS
Environment: Windows 11 (venv)