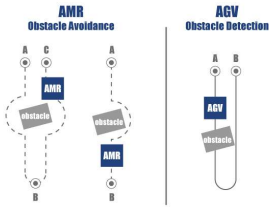
AGV Vs AMR



Potential Application: Material handling, delivery, logistics, hazardous locations,

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Individual Feature	AMR	AGV
Driving method	Autonomous driving method allows free movement to the target	Requires continuous driving route input between trips, such as QR, rail, and Braille code
Obstacle avoidance	When encountering obstacles between movement paths, it uses new mapping to avoid the obstacles and reach the destination.	When it detects obstacles between movement paths, it comes to a stop while traveling on the rail.
Loading weight	Relatively light weight can be loaded	Capable of carrying relatively heavy weights
Speed	Relatively fast	Relatively slow
Accuracy	Error less than 3~5cm	Error less than 1cm
Unit price	Around 20 million to 100 million won	Around 5 to 15 million won

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Agv Vs AMR

Automated Guided Vehicle (AGV):

- Infrastructure Requirements
- Simpler technology and algoethm
- initial setup and installation efforts.

Autonomous Mobile Robot (AMR):

- Versatility
- Complex advanced
- Real time data processing
- Decision making

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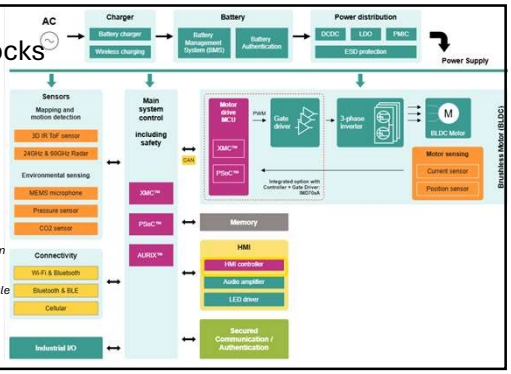
Building blocks

- *Chassis*
- *Sensors*
- *LiDAR*
- *Cameras*
- *Sensors*
- *Encoders*
- *Control unit*
- *Navigation*
- *Batteries Power system*
- *Payload handling*
- *Communication Module*
- *Software algorithm*
- *Safety scanners*



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AGV/AMR's different functional block

https://www.infineon.com/cms/en/applications/robotics/mobile-robots/

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Safety standard

USA ANSI B56.5 - 2012

- *Vehicle Safety and Emergency Control*
- *Stopping Distance*
- Guidance System
- *Clearance*
- Speed Limit in Hazard Zones:
- *Escape Routes*

Europe EN1525:1997

- *Scope*
- *Vehicle Safety*
- *Emergency Controls*
- *Guidance System*
- *Warning Devices*

Common safety features in both standard

- *Safety Laser Scanners or Collision Avoidance Systems*
- *Safety PLCs or Relays*
- *Contact Bumpers*
- *Comprehensive Safety Assessment*

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Case study Industrial Applications

Amazon Kiva Robot

Post Office

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AGV Key features

Fig. AGV/AMR key features

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Operating system for AGV and AMR

ROS
Autoware
Robotnik's ROS Navigation Stack
SLAM Libraries
Yujin Robot's ROS-based Framework
MIRA
Microsoft Robotics Developer Studio
Open Source Middleware
VxWorks

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Market Study

- Total Market: $20 billion (2028)
- AGVs and AMRs exceeding 2.7 million units by 2030
- AMR CAGR: 37% (2023-28)
- AGV CAGR: 8.93% (2022-30)
- AGV $8,661.1 million (2030)

Notes: Survey by Yano Research Institute
1. Targets AGVs and AMRs that conform to ISO3691-4 (JIS D6801). Calculated based on the shipment value at manufacturers.
2. The value for 2023 is the projection, and the values after 2024 are the forecasts.

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Localization navigation control algorithm

D* Lite algorithm	• Path planning and obstacle avoidance.
A* algorithm	• Optimal paths
Artificial Potential Field algorithm + A*	• Warehouse environments
Improved Dijkstra algorithm	Resolving AGV conflicts and achieving efficient routing
Heuristic-based algorithms	Just-in-time routing and efficient AGV routing

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Digital twin system for AGV and AMR applications

Key components for Digital Twin

- ***Real-time Data Integration***
- ***Simulation and Visualization***
- ***Predictive Analytics***
- ***Maintenance and Fault Detection***
- ***Integration with Factory Systems***
- ***Testing and Optimization***
- ***Remote Monitoring and Control***

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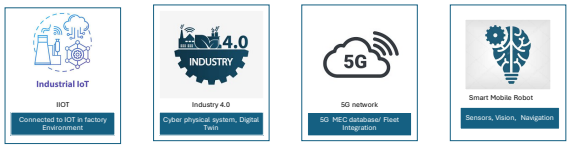
AGV AMR Future Chanllanges



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Cyber physical system for mobile robot

- *Enhanced AI and Machine Learning*
- *Swarm Robotics*
- *5G and Edge Computing*
- *Human-Robot Collaboration*
- *Integration with Warehouse Drones*
- *Advanced Sensing and Perception*
- *Sustainability and Energy Efficiency*
- *Modular and Customizable Solutions*

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Challenges for smart and intelligent Mobile robots

- Ultrasonic guiding
- Inertia guiding
- GPS based system
- Free ranging
- LASER navigation system
- Wireless sensor network
- Barcode and RFID

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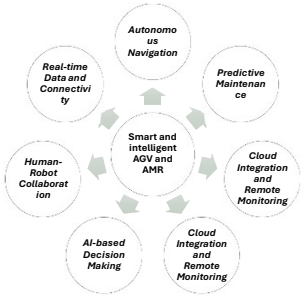
Future trends (AGV/AMR)



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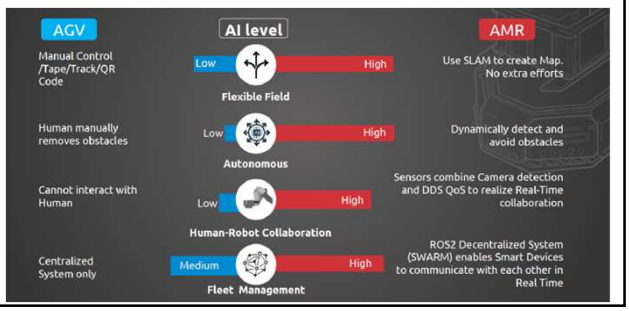

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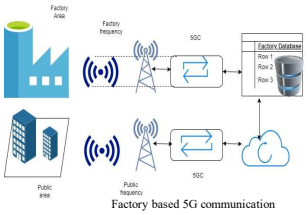
Challenges for 5G Based AGV AMR



Factory based 5G communication

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Challenges for 5G Based AGV AMR

FLEET MANAGEMENT AND CONTROL
AGV/AMR FLEET INTEGRATION WITH 5G MEC FOR FACTORY OF FUTURE
RELIABLE AND PRECISE DOCKING FOR AGVs
RELIABLE 5G NETWORK SLICING AND NETWORK RESOURCE ALLOCATION
WIRELESS COMMUNICATION AND SENSORS' INTEGRATION OVER 5G

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Role in manufacturing

Fig: Role of AGV/AMR in manufacturing

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FMS flexible manufacturing systems

AGVs/AMR

- **Improved Safety**
- **Faster Investment Recovery**
- **Clean and Safe Operation**
- **Scalability**
- **Reduced Assembly Failures**
- **Increased Efficiency**
- **Flexibility**

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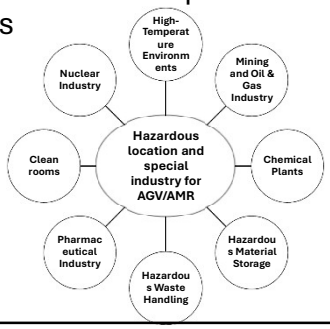
Hazardous location and special industry applications



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