AGV VS AMR SYSTEM ARCHITECTURE

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Robotic Hardware System

Toyota 3AB10

- Manufacturer: Toyota Material Handling, Inc.
- Capacity: 2204lbs
- Overall Height: 91.3 x 14.2 x 7 in.

AUTOMATED GUIDED VEHICLE (AGV)

- AGV refers to a mobile robot that follows predefined paths to transport materials in industrial environments.
- It uses fixed path-following methods like magnetic strips, QR codes, RFID or wires embedded in the floor.
- AGV operates under a centralized system, requiring a warehouse management system (WMS) or fleet controller to control the movements.
- When encountering obstacles, it will stop and requires manual intervention or pre-defined rerouting.
- Commonly used in manufacturing, automotive, and warehouse logistics for material transport and conveyor integration.
- AGVs have high infrastructure dependency as it requires pre-installed paths and external guidance systems, making route modifications costly and time-consuming.

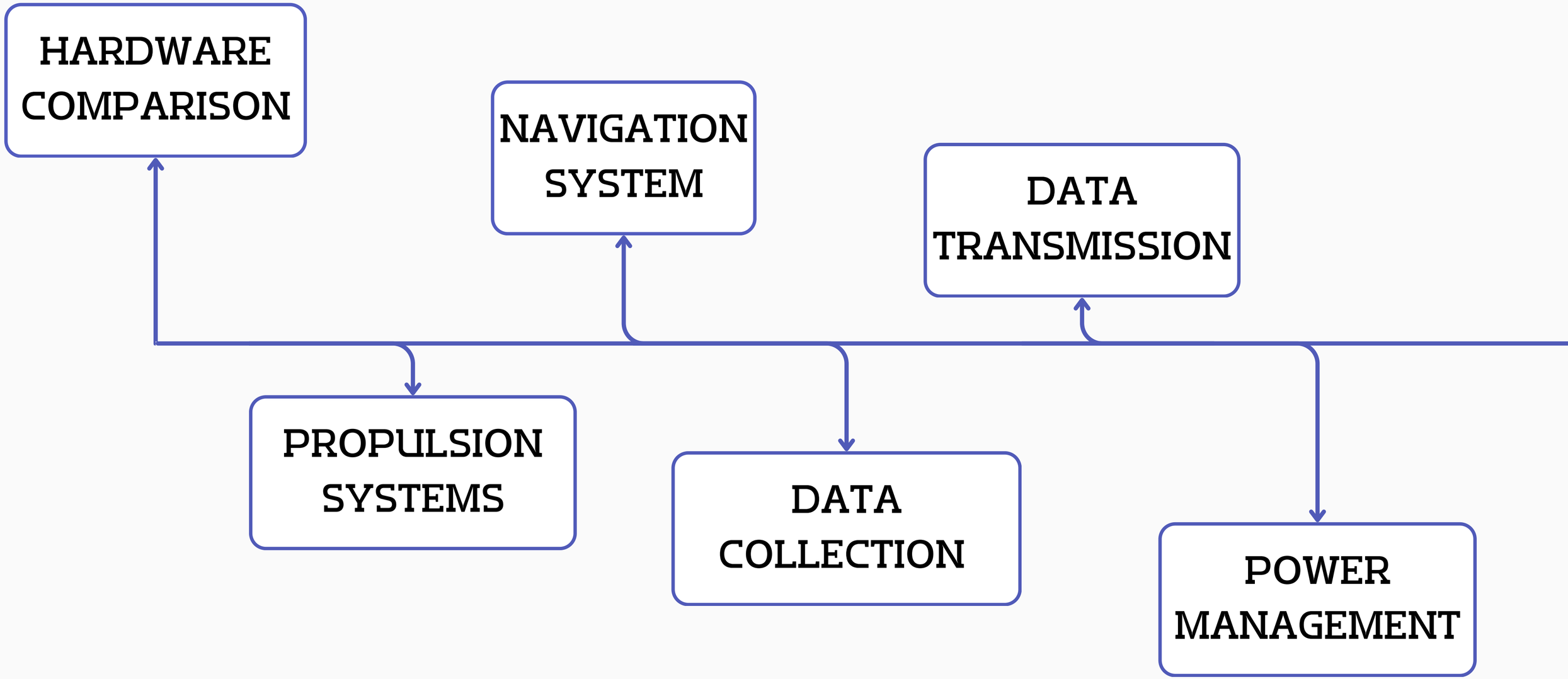
KMP 1500P

- Manufacturer: KUKA Robotics Corporation
- Capacity: 3000lbs
- Dimensions: 78.7 × 31.5 × 18.5 in.

AUTONOMOUS MOBILE ROBOT (AMR)

- AMR refers to a mobile robot that navigates dynamically using SLAM (Simultaneous Localization and Mapping), AI, and sensor fusion to move freely in environments.
- Uses LiDAR, cameras, IMU, and AI algorithms to build a map and autonomously determine the best path in real time.
- Operates independently or communicates with cloud-based IoT and AI systems for fleet coordination.
- When facing obstacles, it will reroute automatically and dynamically without stopping.
- Widely used in e-commerce fulfillment, healthcare, and smart manufacturing, where flexible automation is required.
- AMRs have high infrastructure flexibility as it does not require predefined paths; adapts to changing environments without major infrastructure modifications.

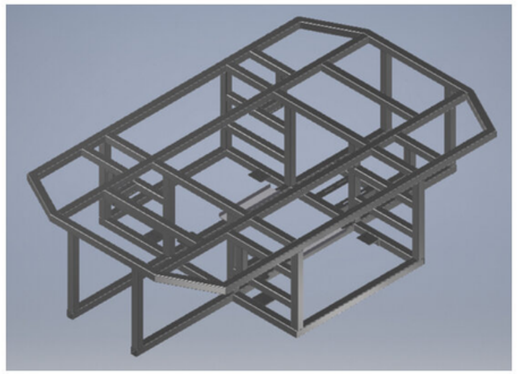
SYSTEM ARCHITECTURE COMPARISON



HARDWARE COMPARISON

AGV

- As AGVs are used to transport heavy loads, they require a strong body to withstand it.
- Thus, AGVs usually have steel chassis.
- They also usually have long bodies to allow for a more equivalent loading. The chassis are usually equipped with sensors such as Lidar and Infrared used for obstacle detection.



AMR

- As AMRs require extensive sensors and computing systems attached to the body, it involves a compact chassis with modular payload system allowing for fast interchangeable loads.
- They also require strong chassis to withstand the hazardous environments that the robot will be subjected to.

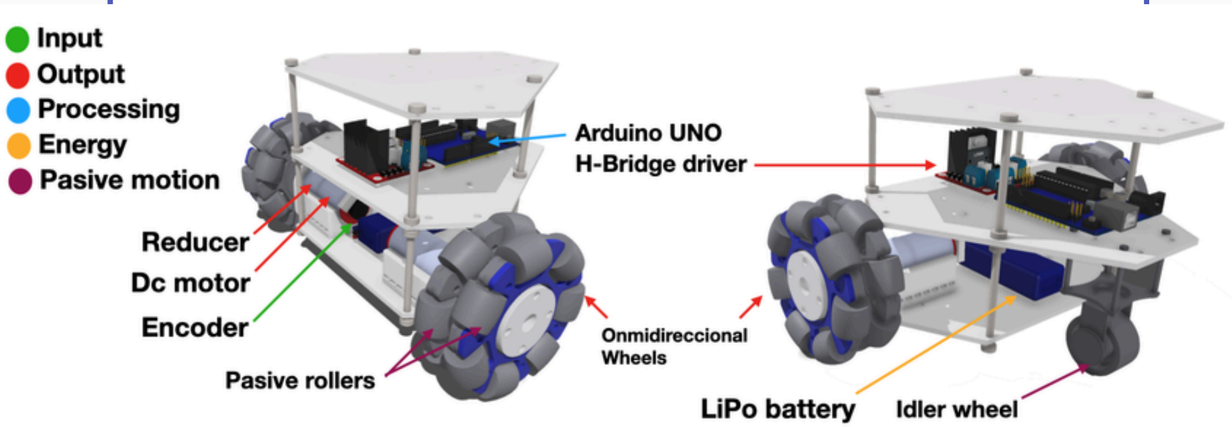
PROPULSION SYSTEMS

AGV

- Uses fixed-drive mechanisms (two-wheel differential, four-wheel, conveyor).
- Uses a DC brushless motors with direct drive gearbox.
- Steering limited to predefined routes and the robot can only moves forward/ backward following the guide, it cannot stray.

AMR

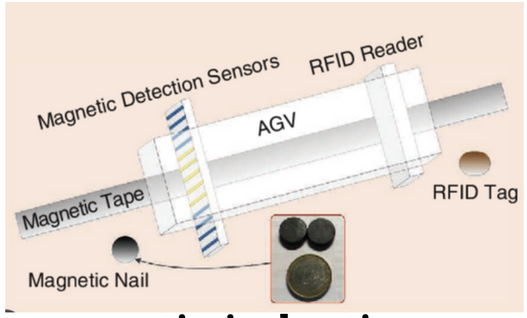
- Uses omnidirectional or differential drive, allowing for flexible movement.
- Since AMRs involve dynamic movement in real-time, it requires an adaptive speed and direction control.



NAVIGATION SYSTEMS

AGV

- AGV relies on external guidance such as magnetic strips, QR codes, RFID or tracks to navigate through the warehouse.
- Both the QR code and RFID tags work by storing data instructions or directions used to direct the robot. Eg. “Turn Left / Slow down speed by 50%”
- Thus in the event that the robot encounters obstacle in its path, it cannot reroute autonomously and will stop.



- 3AB10T uses magnetic induction.

AMR

- Uses SLAM (Simultaneous Localization and Mapping) with LiDAR for 360deg view & cameras.
- It allows for real-time path planning, thus it can dynamically avoids obstacles without stopping.
- Most AMRs are also equipped with bumpers to reduce impact in the case of collision.

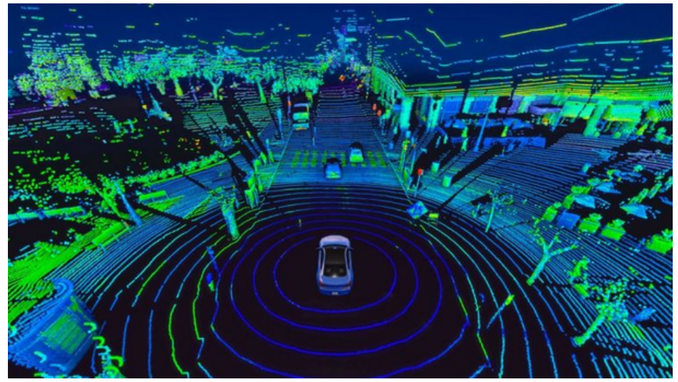
DATA COLLECTION

AGV

- Since the robot has a guide for moving, it does not require extensive sensors. Thus, most AGVs are only equipped with basic sensors such as infrared, ultrasonic and simple LiDAR.
- These sensors are used for obstacle avoidance, positioning and detecting environmental conditions (light, temp, etc.)
- It does have a limited perception and often requires external control for obstacle handling.

AMR

- AMRs are equipped with extensive array of sensors such as multi-LiDAR, depth cameras, radar, IMU, AI-based perception.
- Sensors are used to detects people, objects, and dynamic environments for better decision-making and send continuous spatial data for the SLAM-based navigations.
- Some AMRs are also equipped with weight sensors to ensure proper load handling.



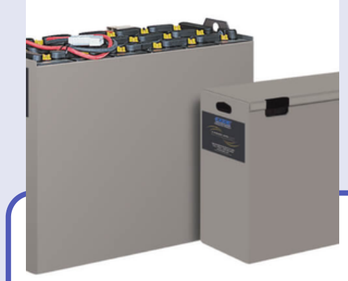
DATA TRANSMISSION

AGV

- 3AB10 rely on precise and structured data transmission for navigation, task execution, and system integration.
- Uses Wi-Fi to transmit navigation and operational data. It also has a CAN Bus for internal data exchange between motors, controllers and safety systems.
- Uses Toyota T-ONE Fleet Management System to coordinates multiple AGVs in real-time and V2V (Vehicle-to-Vehicle) communication system to prevents collisions and optimizes path selection.
- Has integrated Warehouse Management System (WMS) for pick-and-place tasks from logistics software and Programmable Logic Controllers (PLC) for factory automation and data execution.

AMR

- KMP 1500 rely on real-time data transmission for an efficient autonomous operation.
- It uses Wi-Fi or 5G cellular data to allow for high speed data transfer, and uses CAN Bus to connects the internal components like motors, controllers and sensors.
- Uses edge computing and cloud integration to process navigation data onboard and to allows remote monitoring and firmware updates through IoT.
- It also uses has a specific software for centralized data exchange for fleet management. There are also V2X (Vehicle-to-Everything Communication) which shares movement data with other robots and systems to avoid collision.



POWER MANAGEMENT

AGV

- Uses basic lead-acid which has a longer runtime than Lithium-ion batteries with around 12 hrs runtime for 6hrs charge (depending in the load weight).
- The robot will autonomously move to the docking station when the battery level is low.
- It has a battery swapping system which allows for a quick battery replacement and Battery Management System (BMS) which monitors voltage, temp, charge cycles to extend battery life.
- Other AGVs may use conductive charging which uses contact plates for efficient energy station.

AMR

- Uses advanced lithium-ion batteries with a typical runtime of 8 hrs with 2hrs of recharge (depending on load and task complexity).
- KMP 1500 supports wireless/inductive charging for continuous operation.
- Once the battery level gets low, the robot will be automatically routed to a free charging station.
- Similar to AGVs, AMRs also has Smart Battery Monitoring System which may be upgraded by connecting it with IoT for remote checking.

COMPARISON

FEATURE	AGV	AMR
Navigation	Fixed Paths and predefined routes	Dynamic & AI-driven with Real-time Obstacle Avoidance
Sensors	Basic IR, LiDAR	Multi-LiDAR, Cameras, AI
Data Processing	External Control	Onboard AI & Edge Computing
Power	Lead-acid/Conductive Charging	Lithium-ion, Wireless Charging
Price Range Per Unit (May vary based on optional features, integration system and bulk discount)	$40,000 to $100,000	$100,000 to $150,000

- AGV: Best for fixed-path, structured environments.
- AMR: Best for dynamic, real-time operations with AI-based adaptability.

THANK YOU