MCTE 4362

THE STUDY OF AGV/AMR

BRIEF HISTORY - APPLICATIONS - MAIN COMPONENTS

ROBOTIC
HARDWARE SYSTEM

WHAT IS AGV & AMR?

An autonomous mobile robot (AMR) is a self-contained vehicle that is capable of navigating and performing tasks without human intervention. AMRs typically use sensors, cameras, and other technologies to perceive their environment and make decisions about how to move and interact with objects. They are used in a variety of applications, such as logistics, manufacturing, and healthcare, to automate repetitive or hazardous tasks and improve efficiency.

An autonomous ground vehicle (AGV) is a type of mobile robot that operates on the ground. Unlike AMRs, which are typically smaller and designed for indoor use, AGVs can be much larger and used in outdoor environments such as warehouses, factories, and even on public roads. They are often used for material handling and transportation tasks, and may be equipped with features such as GPS, LiDAR, and other sensors to help them navigate and avoid obstacles.

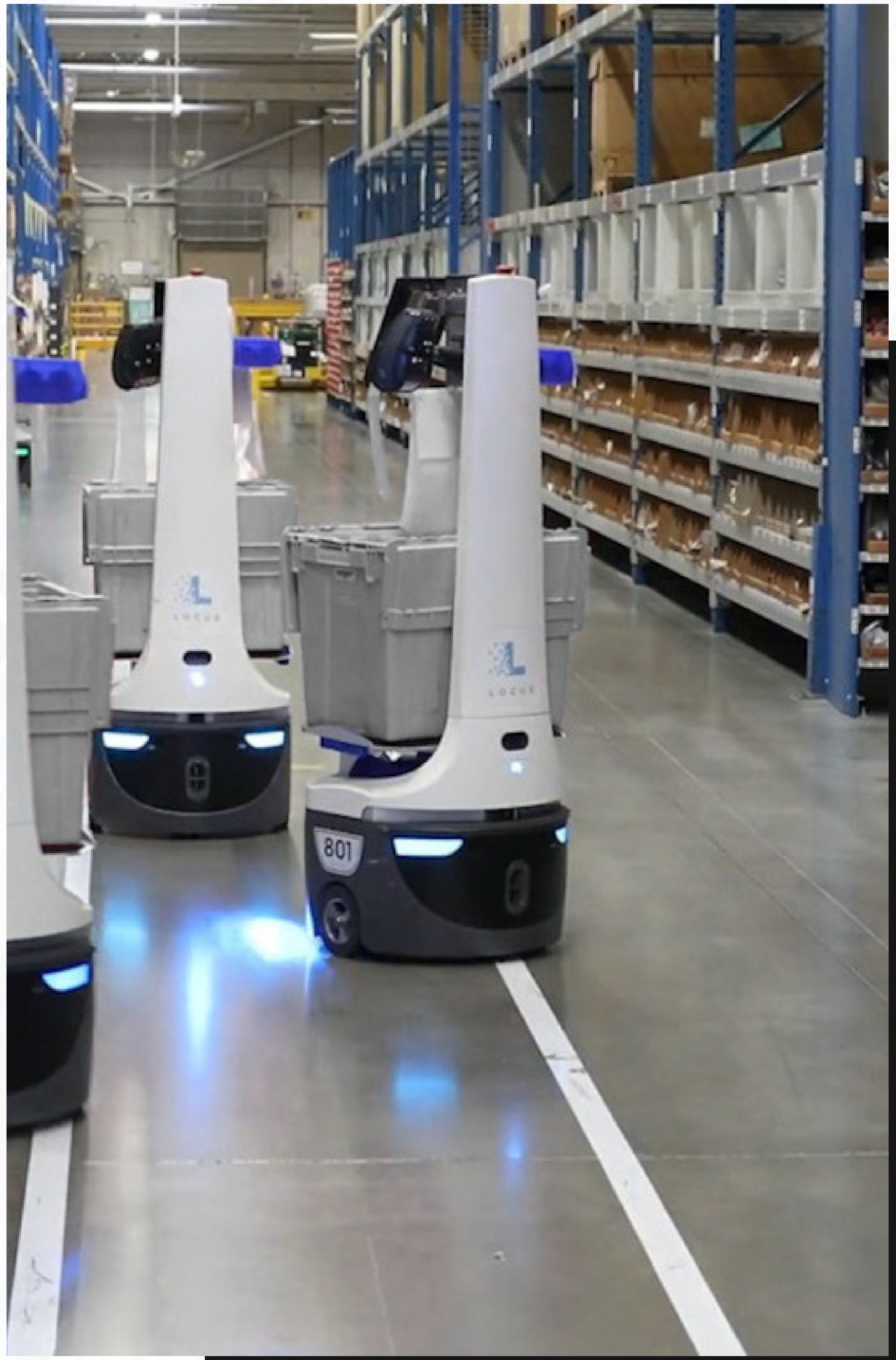
BRIEF HISTORY OF AGV & AMR

The history of autonomous mobile robots and autonomous ground vehicles dates back several decades, but the development of these technologies has accelerated in recent years due to advances in computer vision, machine learning, and other fields.

The first documented autonomous mobile robot was the "Shakey" robot, developed by researchers at Stanford University in the late 1960s and early 1970s. Shakey was equipped with a TV camera, laser range finder, and other sensors, and was capable of navigating around obstacles and completing simple tasks such as pushing objects.

In the 1980s and 1990s, research into autonomous mobile robots continued, and several companies began developing commercial applications for these technologies. One of the earliest commercial applications was in the field of warehouse automation, where autonomous robots were used to transport goods around large facilities.

In recent years, advances in artificial intelligence and machine learning have made it possible to develop more sophisticated autonomous mobile robots and autonomous ground vehicles. These technologies are now being used in a wide range of applications, from logistics and manufacturing to healthcare and agriculture.



APPLICATIONS OF AMR

AMR applications are based on their specific application and the environment they will be used. These are some applications on AMR nowadays

DELIVERY ROBOTS

These AMRs are designed to transport goods and packages from one location to another. They are commonly used in logistics and e-commerce industries.

CLEANING ROBOTS

These AMRs are designed to clean floors, carpets, and other surfaces in indoor environments such as offices, hospitals, and airports.

INSPECTION ROBOTS

These AMRs are designed to perform visual inspections of equipment and infrastructure, such as pipelines, bridges, and wind turbines.

SECURITY ROBOTS

These AMRs are designed to patrol and monitor areas, such as parking lots, warehouses, and shopping malls.

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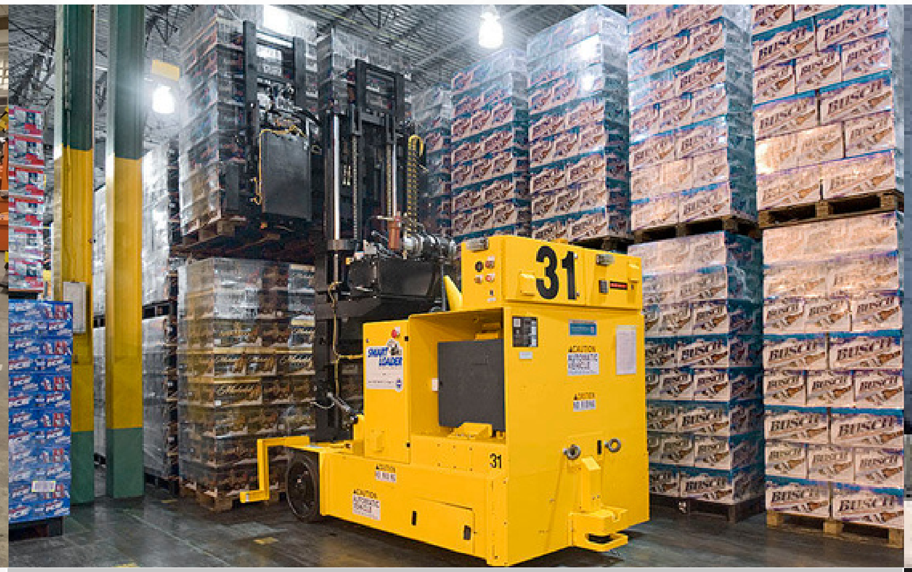


FORKLIFT AGVS

These AGVs are designed to transport and move pallets and other heavy loads within warehouses and factories.

TUGGER AGVS

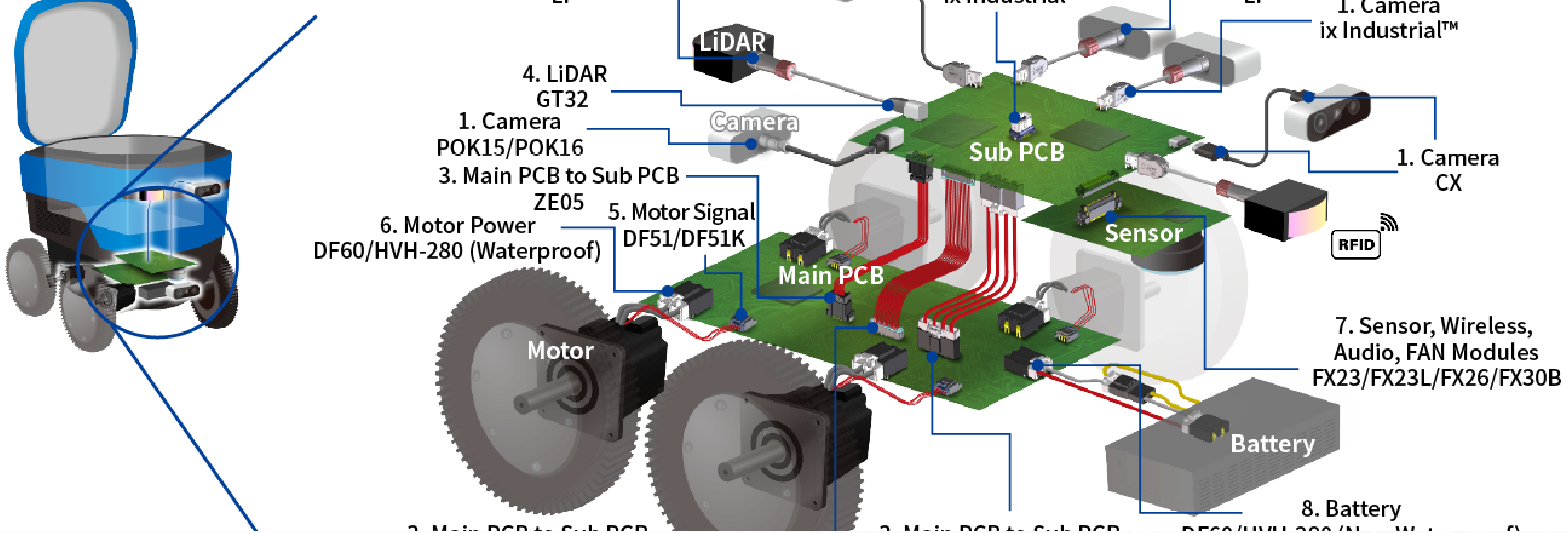
These AGVs are designed to pull carts or other loads along a predetermined path, typically in a manufacturing or assembly line setting.

AUTOMATED GUIDED CARTS (AGCS)

These AGVs are similar to tugger AGVs, but they are designed for smaller loads and shorter distances.

AUTONOMOUS BUSES AND TAXIS

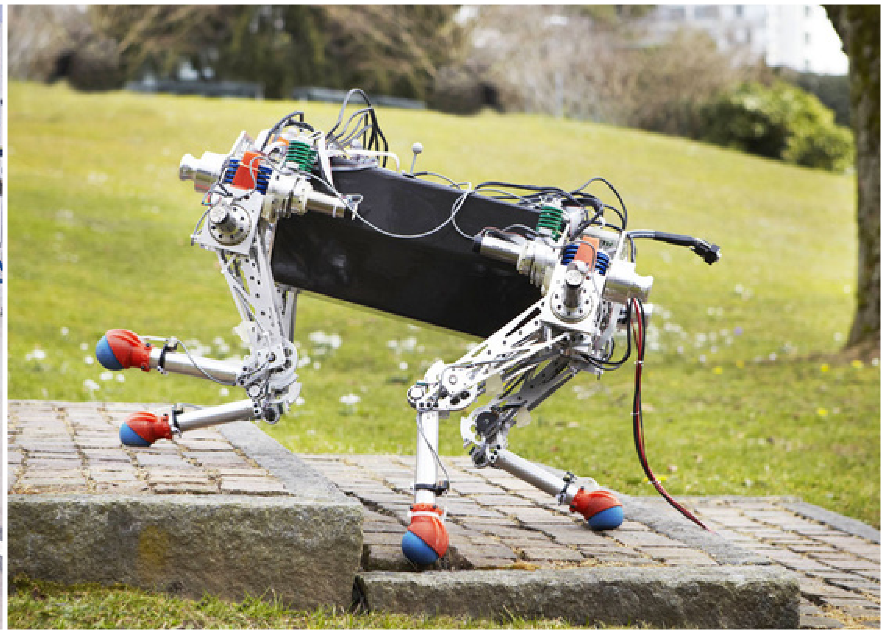
These AGVs are designed to transport passengers within a specific area, such as a campus or a city center.

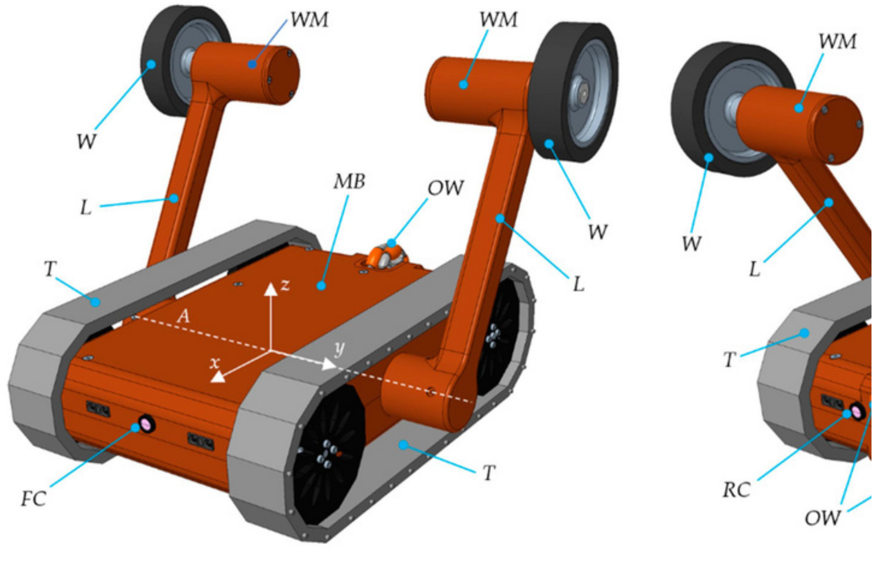


MAIN COMPONENTS OF AGV&AMR

FRAME

The frame or chassis of an autonomous mobile robot (AMR) or autonomous ground vehicle (AGV) is an important design element that supports the robot's components and provides structural stability. The frame or chassis design can vary depending on the specific application and industry





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Wheeled frames

Many AMRs and AGVs are designed with a wheeled chassis, which allows the robot to move along a flat surface. Depending on the size and weight of the robot and the environment in which it will be used, the wheels may be driven by electric motors, hydraulic motors, or other types of actuators.

Tracked frames

Tracked frames, also known as crawler frames, are another common design for AGVs and other types of mobile robots. Tracked frames use continuous tracks or treads to move over rough or uneven terrain, making them well-suited for outdoor environments.

Legged frames

Some AMRs and AGVs are designed with legged frames, which use legs instead of wheels or tracks for movement. Legged frames can be particularly useful for robots that need to navigate uneven or rocky terrain, such as search and rescue robots.

Hybrid frames

In some cases, AMRs and AGVs may use a hybrid frame design that combines elements of multiple frame types. For example, a robot might have wheels for smooth surfaces and tracks for rough terrain, or legs for difficult terrain and wheels for flat surfaces.

PROPULSION SYSTEM

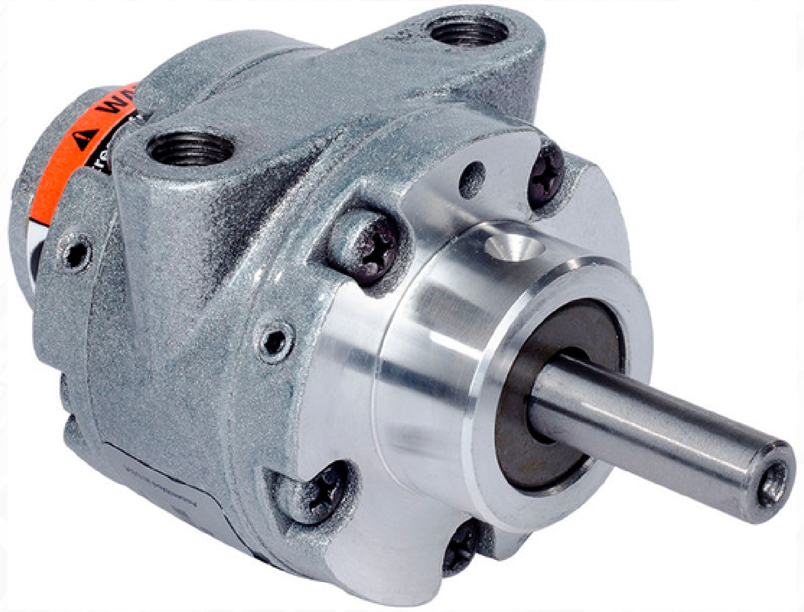
The propulsion system of an autonomous mobile robot (AMR) or autonomous ground vehicle (AGV) is responsible for providing the robot's movement and locomotion. The choice of propulsion system will depend on the specific application and industry, but here are some common types of propulsion systems for AMRs and AGVs:

Electric Motors

Many AMRs and AGVs are powered by electric motors, which provide a quiet and efficient means of propulsion. Depending on the size and weight of the robot and the environment in which it will be used, the electric motors may be powered by batteries or other types of energy storage.

Hydraulic Motors

Hydraulic motors can be used to provide high torque and power to larger AGVs, such as those used in material handling applications. Hydraulic systems can be more complex and expensive than electric systems, but they are well-suited for heavy-duty applications.



Pneumatic Motors

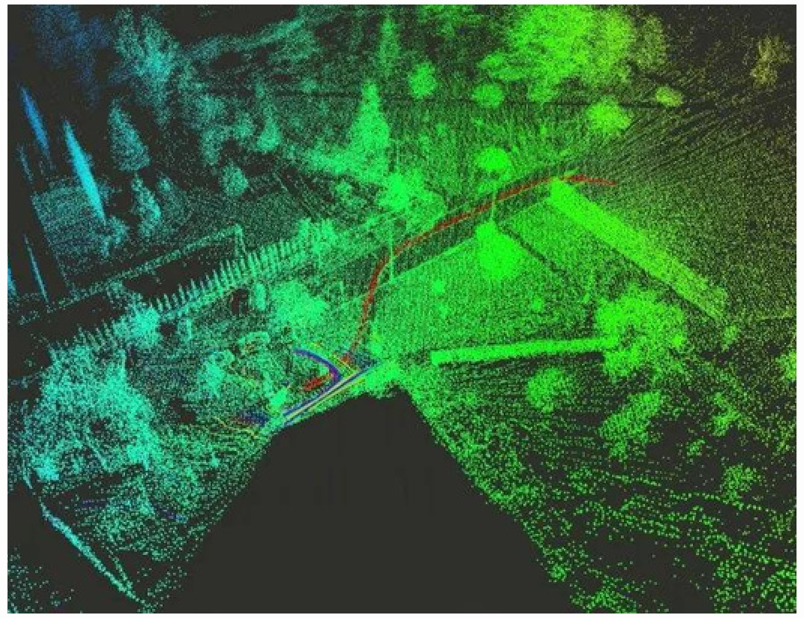
Pneumatic motors use compressed air to drive the robot's wheels or other propulsion mechanisms. Pneumatic systems can be less expensive than hydraulic systems, but they are generally less powerful and efficient.

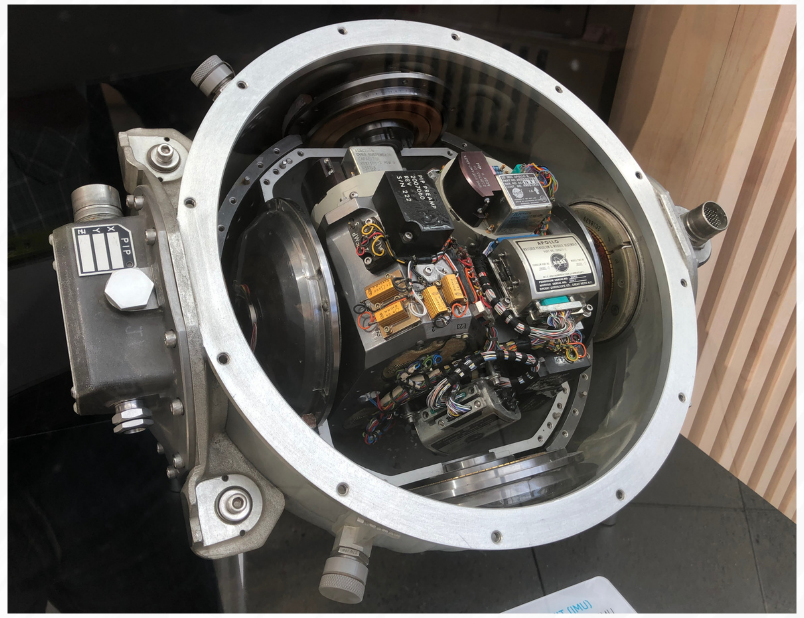
Hybrid System

: In some cases, AMRs and AGVs may use a hybrid propulsion system that combines elements of multiple propulsion types. For example, a robot might use electric motors for smooth surfaces and switch to hydraulic or pneumatic motors for rough terrain.

NAVIGATION & CONTROL SYSTEM

The navigation and control system of a UAV are critical for its safe and effective operation. Here are some of the common components of a UAV's navigation and control system:





Simultaneous Localization and Mapping (SLAM)

SLAM is a common technique used for navigation in autonomous robots. SLAM uses a combination of sensors, such as LiDAR, cameras, and odometry, to create a map of the robot's environment and determine its position within that environment.

Global Positioning System (GPS):

GPS is a satellite-based navigation system that can be used to determine a robot's position on the Earth's surface. GPS can be useful for outdoor applications where the robot has a clear line of sight to the sky.

Inertial Measurement Unit (IMU)

An IMU is a sensor package that includes accelerometers, gyroscopes, and magnetometers, which can be used to determine the robot's orientation and movement. IMUs are commonly used in combination with other navigation techniques, such as SLAM or GPS.

NAVIGATION & CONTROL SYSTEM

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Control Systems

In addition to navigation, AMRs and AGVs require control systems to execute their movements and actions. Control systems can include algorithms for path planning, obstacle avoidance, and motion control, as well as interfaces for human operators to monitor and control the robot.

Cloud-based systems

Some AMRs and AGVs may use cloud-based navigation and control systems that rely on data from remote sensors and algorithms to guide the robot's movements. Cloud-based systems can be useful for applications where the robot needs to be able to adapt to changing conditions or where real-time data analysis is required.

DATA COLLECTION OF AGV&AMR

Data collection is an important aspect of autonomous mobile robots (AMRs) and autonomous ground vehicles (AGVs) as it enables the robots to gather information about their environment, their own performance, and any other relevant data that can be used to improve their operation.

DATA TYPE COLLECTED

- **Sensor data:** This includes data from sensors such as LiDAR, cameras, ultrasonic sensors, and other types of sensors used to detect the robot's environment. Sensor data can include information about the robot's location, speed, acceleration, orientation, and the presence of obstacles or other objects in the environment.
- **Telemetry data:** This includes data about the robot's performance, such as its speed, battery level, and other performance metrics. Telemetry data can be used to monitor the robot's performance in real-time and to identify any issues that may need to be addressed.
- **Log data:** This includes data about the robot's operation, such as when it was started or stopped, how long it has been running, and any errors or issues that have occurred during operation. Log data can be used for troubleshooting and maintenance purposes.
- **Cloud-based data:** Some AMRs and AGVs may generate or receive data from cloud-based systems that can be used to optimize their operation. This data may include information about the robot's environment, performance, and other factors that can be used to improve its efficiency and effectiveness.
- **Maintenance data:** This includes data about the robot's maintenance needs, such as when it was last serviced, what parts have been replaced, and any other relevant maintenance information. Maintenance data can be used to ensure that the robot is operating at peak efficiency and to schedule maintenance activities when needed.

DATA TRANSMISSION

Data transmission is an important aspect of autonomous mobile robots (AMRs) and autonomous ground vehicles (AGVs) as it allows them to communicate with other systems and devices, such as control systems, cloud-based systems, and other robots in a fleet. Here are some common methods for data transmission in AMRs and AGVs:

Wireless Communication

AMRs and AGVs often use wireless communication methods, such as Wi-Fi, Bluetooth, or cellular networks, to transmit data to other systems and devices. Wireless communication allows the robot to transmit data in real-time, enabling it to respond quickly to changes in its environment.

Ethernet

Some AMRs and AGVs use Ethernet connections to transmit data to other systems and devices. Ethernet connections can provide fast and reliable data transmission, making them a good choice for applications that require high-speed data transfer.

Serial Communication

Some AMRs and AGVs use serial communication methods, such as RS-232 or RS-485, to transmit data to other systems and devices. Serial communication can be a simple and reliable way to transmit data over short distances.

Cloud-Based Systems

Some AMRs and AGVs transmit data to cloud-based systems, which can be used to analyze the data across a fleet of robots. Cloud-based systems can provide a centralized location for data storage and analysis, allowing for real-time monitoring and optimization of the robots' operation.

POWER MANAGEMENT

Power management is a critical aspect of autonomous mobile robots (AMRs) and autonomous ground vehicles (AGVs) as it directly impacts their operational capabilities and overall performance.

- **Battery technology:** Most AMRs and AGVs are powered by rechargeable batteries. The choice of battery technology can significantly impact the robot's performance, including its run time and overall lifespan. Some popular battery technologies for AMRs and AGVs include lithium-ion, nickel-metal hydride (NiMH), and lead-acid batteries.
- **Battery management system (BMS):** A BMS is a system that monitors and controls the charging and discharging of a battery to optimize its performance and prolong its lifespan. BMS can help to ensure that the battery is charged and discharged at the appropriate rates and temperatures, preventing damage to the battery and improving its overall efficiency.
- **Energy regeneration:** Some AMRs and AGVs use energy regeneration to capture and reuse energy that is generated during braking or deceleration. This can help to reduce the overall energy consumption of the robot and improve its efficiency.
- **Power monitoring:** Power monitoring systems can be used to track the power consumption of an AMR or AGV, enabling operators to identify potential inefficiencies or issues that may be impacting the robot's performance.
- **Scheduled charging:** Many AMRs and AGVs are programmed to follow a scheduled charging regimen to ensure that they are always fully charged and ready for operation. This can help to prevent downtime and ensure that the robot is always available when needed.

THANK YOU

'It matters little how much equipment we use, it matters much that we be masters of all we do use' Sam Abell