AUTOMATED GUIDED VEHICLES (AGV) & AUTONOMOUS MOBILE ROBOTS (AMR)

MCTE 4362 (ROBOTIC HARDWARE SYSTEM)

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01

INTRODUCTION

WHAT IS AGV?

- An Automated Guided Vehicle (AGV) is a mobile robot that follows a pre-programmed path to perform tasks such as material handling, transportation, and logistics
- They are equipped with sensors and cameras that allow them to navigate and avoid obstacles, and they can communicate with other systems to receive instructions and update their status
- Can help businesses reduce costs and increase productivity by improving efficiency, safety, and accuracy in material handling and transportation

WHAT IS AMR?

- An Autonomous Mobile Robot (AMR) is a self-guided mobile robot that can navigate and perform tasks in a variety of environments
- It use sensors and cameras to perceive their surroundings and create a map of their environment
- Can then use this map to navigate and avoid obstacles autonomously
- Used in industries such as warehousing, manufacturing, and logistics for tasks such as material handling, transportation, and inventory management
- Can be programmed to follow specific routes, perform specific tasks, and communicate with other systems to receive instructions and update their status
- Can help businesses improve efficiency, safety, and productivity by reducing the need for human intervention in repetitive or hazardous tasks

SIMILARITIES BETWEEN AGV & AMR

01

Material handling

Used for material handling and logistics tasks.
Eg: transportation, inventory management, and palletizing

02

Automation

Both are autonomous or semi-autonomous, so they can perform tasks without the need for direct human intervention

03

Safety

Both are designed with safety features to prevent collisions with objects or people in their environment

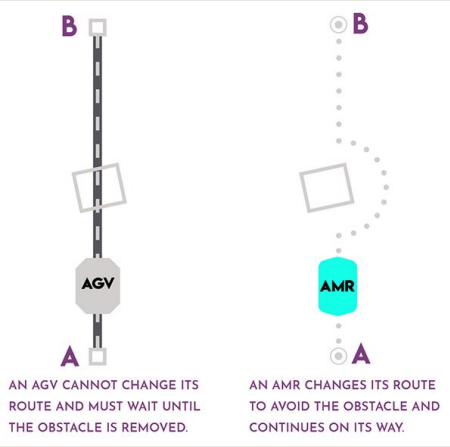
04

Technology

Use similar sensing and mapping technologies, such as LiDAR and cameras, to perceive their surroundings and navigate autonomously

DIFFERENCES BETWEEN AGV & AMR

	Automated Guided Vehicle (AGV)	Autonomous Mobile Robot (AMR)
Navigation	Follow pre-programmed paths or tracks	Use sensors and mapping technology to navigate autonomously
Flexibility	Designed for a specific application or use case	Designed to be more flexible and adaptable to a variety of tasks and environments
Cost	Less expensive because have simpler in design and functionality	Expensive
Installation & maintenance	Require more infrastructure and maintenance, such as tracks or magnetic tape	Require less infrastructure and are easier to install and maintain
Capacity	Used for larger loads or pallets	Better for smaller loads and more flexible handling



02

HISTORY

HISTORY OF AGV

Developed for use in manufacturing plants, where simple vehicles that followed a track or wire embedded in the floor 1950s, by **Barrett Electronics of Northbrook, Illinois**

1950

1960

Expanded to other industries such as automotive, food and beverage, and warehousing

Development of microprocessors and computer control system cause increase in the use of AGVs in manufacturing and material handling

1970

2000

Introduction of artificial intelligence and machine learning algorithms, allowing to make more informed decisions and operate more efficiently

Development of cloud computing and the Internet of Things (IoT) to be integrated with other systems and data sources, improving efficiency and productivity

2010

Now

Widely used in various industries for material handling and logistics tasks

HISTORY OF AMR

Early 2000

Developed for use in military and defense applications

Mid 2000

Expanded to other industries such as warehousing and logistics, where they were used for material handling and transportation tasks

Late 2000

More advanced sensors and mapping technologies, such as LiDAR and simultaneous localization and mapping (SLAM)

Early 2010

Development of cloud computing and the Internet of Things (IoT) enabled AMRs to be integrated with other systems and data sources

Mid 2010

Expanded to other industries such as healthcare, retail, and hospitality, where they were used for tasks such as inventory management, cleaning, and customer service

Now

Development of artificial intelligence and machine learning algorithms has enabled AMRs to become more intelligent and adaptive

03

APPLICATIONS

APPLICATIONS OF AGV & AMR

01

MANUFACTURING

Transporting raw materials, work-in-progress, and finished products between different production processes

02

WAREHOUSING AND LOGISTICS

To move goods between storage areas, loading docks, and shipping areas

03

HEALTHCARE

Delivering medications, transporting medical equipment, and moving patient records

04

RETAIL

Restocking shelves, transporting merchandise between storage areas and sales floors, and managing inventory

05

FOOD AND BEVERAGE

Transporting raw materials, finished products, and packaging materials between different processing areas

06

AGRICULTURE

Tasks such as planting, harvesting, and transporting crops

04

MAIN COMPONENTS OF ROBOT

1.0
HULL DESIGN, BODY TYPES & DESIGN

HULL DESIGN OF AGV & AMR

Size & Shape

Hull should also be compact enough to navigate through narrow aisles and tight spaces

Material

Should be durable, lightweight, and resistant to wear and tear

Wheels

Use either two or four wheels, which can be either omnidirectional or fixed-directional

Sensors

Sensors such as laser scanners, cameras, and proximity sensors are used to navigate the robots and avoid obstacles

Power Source

Can be either battery or wired. The hull should have enough space to store the battery and the charging system

Safety Features

Emergency stop buttons and warning lights are important features to ensure the safety of operators and preventing accidents

AGV BODY TYPES & DESIGN

Flatbed

- Consists of a flat surface where materials or products can be loaded and transported
- Typically used in manufacturing and warehousing applications

Tugger

- Designed to pull multiple carts or trailers
- Commonly used in distribution centers and warehouses to transport goods between different areas

Forklift

- Designed to lift and move pallets or other heavy loads
- Commonly used in manufacturing and distribution centers

Unit Load

- Designed to transport individual loads, such as boxes or crates
- Commonly used in manufacturing and distribution centers

Pallet Truck

- Designed to lift and move pallets.
- Commonly used in manufacturing and distribution centers

Conveyor

- Designed to transport goods on a conveyor belt
- Commonly used in manufacturing and distribution centers to move goods from one production line to another

Hybrid

- Combine the features of two or more types of AGVs, such as tugger and flatbed or forklift and unit load
- Designed for specific applications and environments where multiple types of AGVs are required

AMR BODY TYPES & DESIGN

Flatbed

- Consist of a flat surface where materials or products can be loaded and transported
- Used in manufacturing and warehousing applications

Cart

- Designed to transport smaller loads, such as boxes or small packages
- Commonly used in healthcare facilities and retail applications.

Humanoid

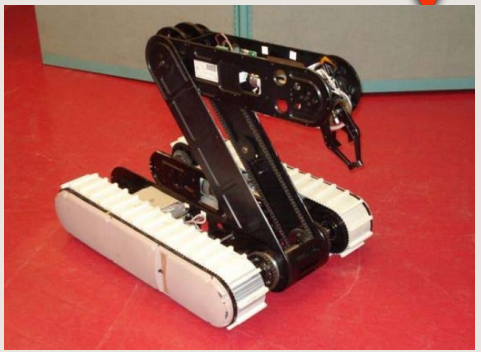
- Designed to resemble a human form, which allows to interact with people and perform tasks that require dexterity and fine motor skills
- Commonly used in research and development

Inspection

- Designed to perform tasks such as quality control, inspection, and data collection
- Equipped with sensors and cameras to detect defects, measure dimensions, and collect data

Swarm

- Work together in a coordinated manner to perform tasks such as cleaning, maintenance, and inspection
- Can communicate with each other and adapt to changes in the environment



Hybrid

- Combine the features of two or more types of AMRs, such as cart and inspection or humanoid and
- Designed for specific applications and environments where multiple types of AMRs are required

2.0 PROPULSION SYSTEM (LOCOMOTION)

Factors such as load capacity, speed, maneuverability, and surface type will all play a role in determining the most suitable wheel type for the AGV or AMR

AGV & AMR LOCOMOTION

CASTER WHEEL

- Require omnidirectional movement
- Typically made of a hard plastic or rubber material and are designed to rotate in any direction, allowing for maximum maneuverability.

DRIVE WHEEL

- The wheel that is directly powered by the AGV's or AMR's motor
- Typically made of a durable material, such as rubber or polyurethane, and is designed to provide good traction and grip

IDLER WHEEL

- A non-powered wheel that is used to support the AGV's or AMR's weight and maintain tension in the drive wheel

GUIDE WHEEL

- Used to keep the AGV or AMR on its predetermined path
- Typically made of a hard plastic or metal material and is designed to be precise and durable.

TRACTION WHEEL

- Used in AGVs and AMRs that require good traction on rough or uneven surfaces
- Typically made of a soft, high-friction material, such as rubber or polyurethane, and are designed to grip the surface and provide maximum traction

3.0 NAVIGATION SYSTEM & CONTROL

The control system for AGVs and AMRs can vary depending on the specific application and environment. Some robots are programmed to follow a predetermined path, while others use algorithms to plan their own routes.

AGV & AMR NAVIGATION SYSTEM & CONTROL

MAGNETIC GUIDANCE

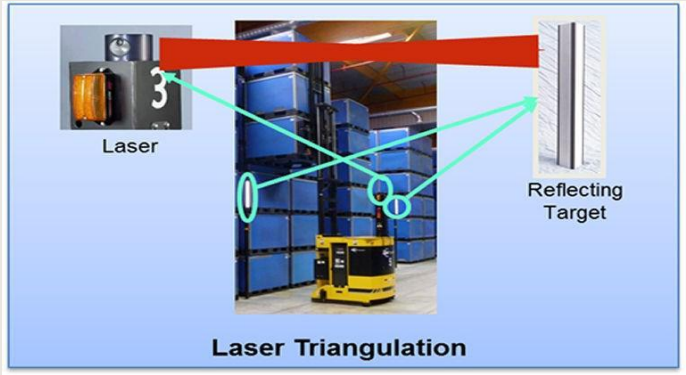
→ Navigation method used by AGVs

Involves the use of magnets embedded in the floor to guide the AGV along a predetermined path. The AGV uses sensors to detect the magnetic field and stay on course

LASER GUIDANCE

→ Navigation method used by AMRs

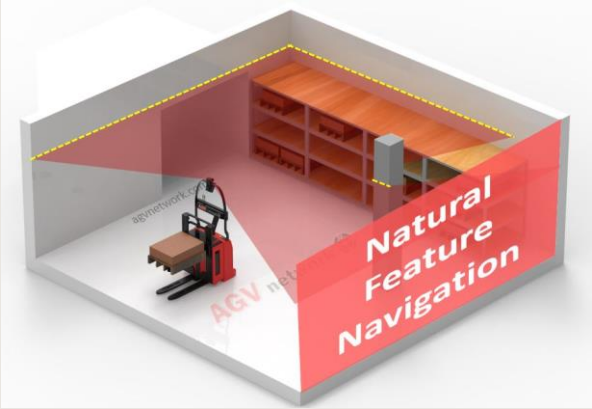
Involves the use of lasers to scan the environment and create a map of the surroundings. The AMR uses this map to plan its route and avoid obstacles



VISION GUIDANCE

→ Navigation method used by some AGVs and AMRs

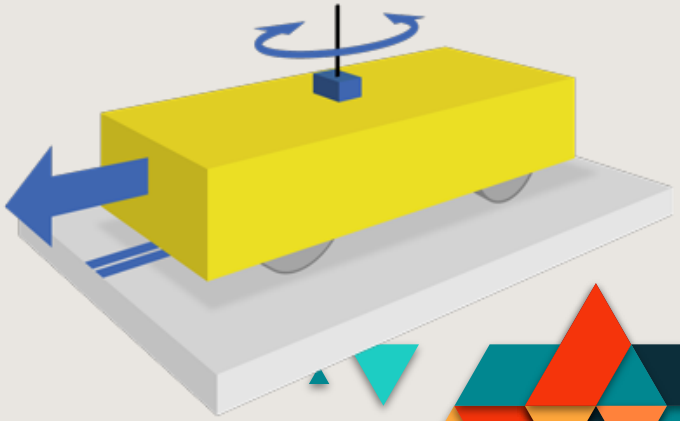
Involves the use of cameras to capture images of the environment and then using computer vision algorithms to analyze the images and determine the robot's position and orientation



INERTIAL GUIDANCE

→ Navigation method used by some AGVs and AMRs

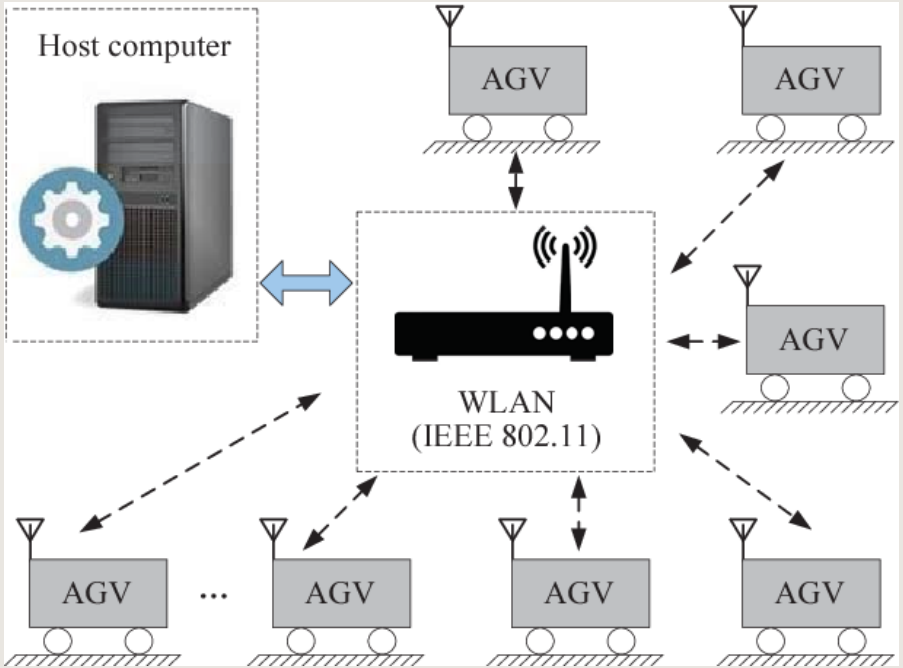
Involves the use of sensors, such as accelerometers and gyroscopes, to measure the robot's motion and orientation



WIRELESS COMMUNICATION

→ Navigation method used by both AGVs and AMRs

Can be controlled wirelessly using a communication system, such as Wi-Fi, Bluetooth, or Zigbee. The control signals can be sent from a central control system or from a handheld device



4.0 DATA COLLECTION

TYPE OF SENSORS USED IN AGV & AMR

Positioning Sensor

Load Sensor

Temperature & Humidity Sensor

Obstacle Detection Sensor

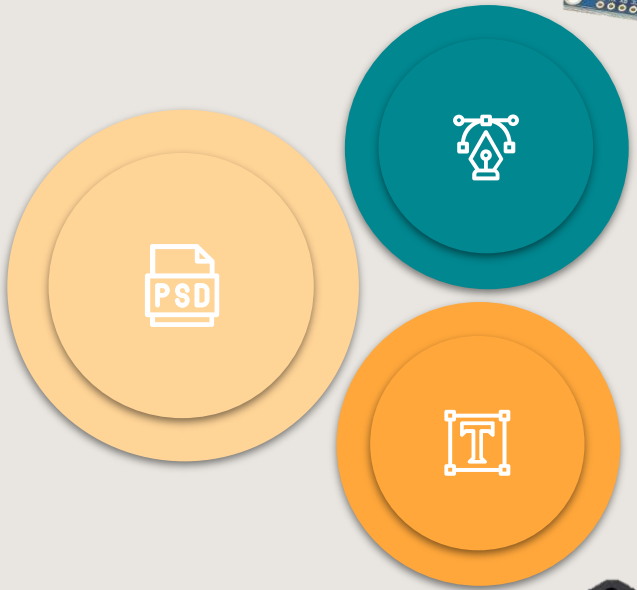
Battery Sensor

Communication Sensor

1. Positioning Sensor

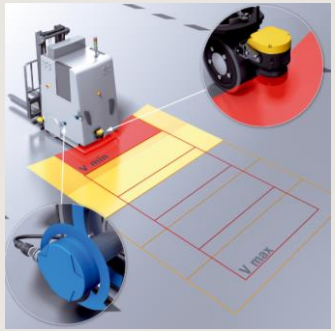
GPS (Global Positioning System)

Uses satellites to determine the robot's location



Laser Scanner

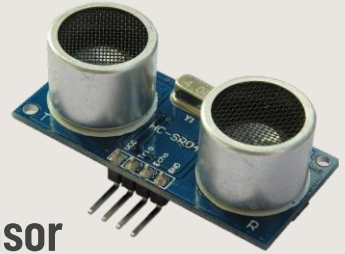
Emit laser beams and use the reflection to create a map of the robot's surroundings



Inertial Sensor

Measure changes in the robot's motion and orientation, allowing the robot to determine its position

2. Obstacle Detection Sensor



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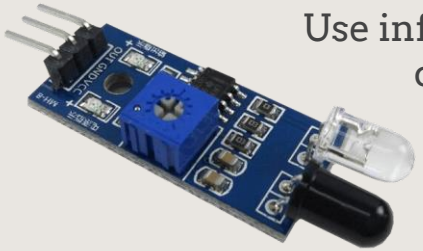
Ultrasonic Sensor

Use sound waves to detect nearby objects

Infrared Sensor

Use infrared light to detect objects



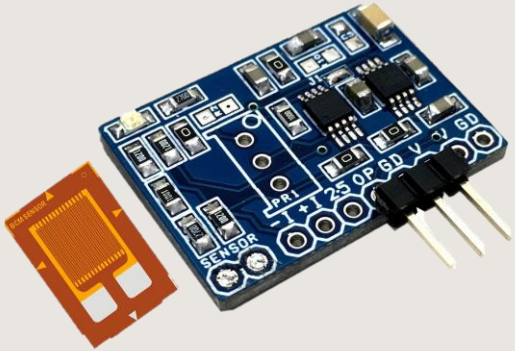
02

03

Camera

Capture images of the robot's surroundings and use image processing algorithms to identify obstacles

3. Load Sensor



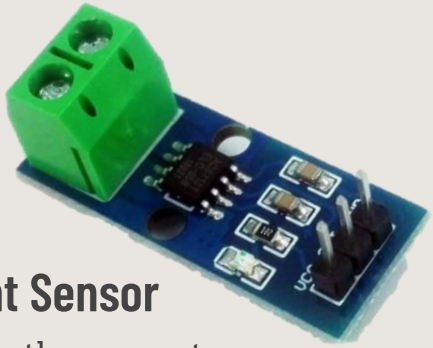
Strain Gauges

Measure changes in resistance caused by deformation in the robot's structure

Load Cells

Measure the force applied to a load-bearing structure

4. Battery Sensor

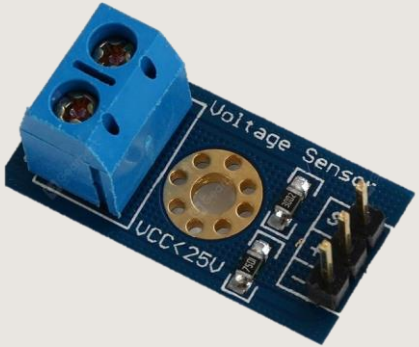


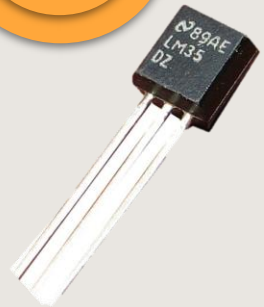
Current Sensor

Measure the current flowing in and out of the battery

Voltage Sensor

Measure the voltage of the battery





Temperature Sensor

Measure the temperature of the battery to ensure it does not overheat

5. Temperature & Humidity Sensor

02

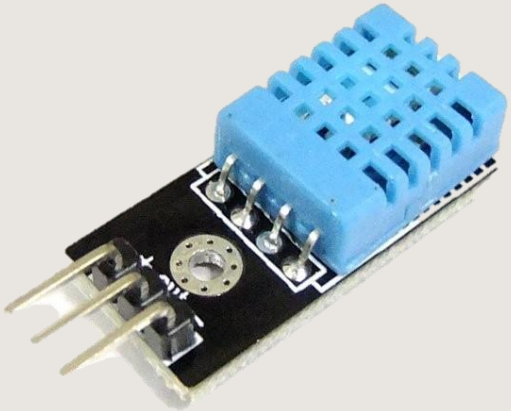
Thermocouples

Measure temperature based on the voltage difference between two wires

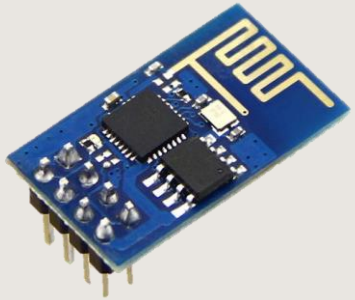
03

Humidity sensors

Measure the moisture content of the air



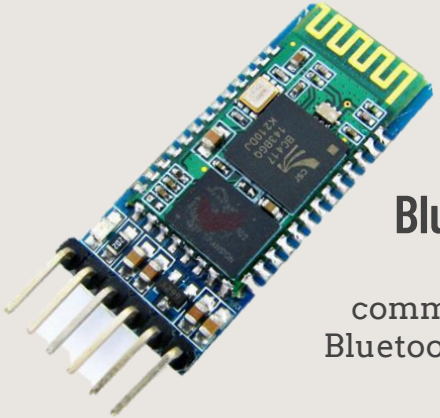
6. Communication Sensor



01

Wi-Fi Modules

Allow the robot to connect to a wireless network



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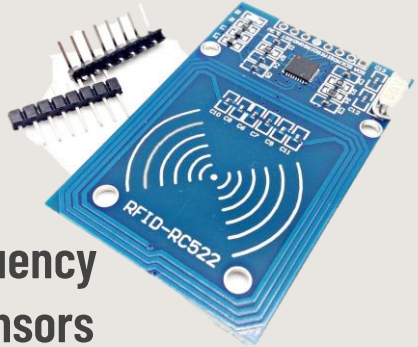
Bluetooth Modules

Allow the robot to communicate with other Bluetooth-enabled devices



03

RFID (Radio-Frequency Identification) sensors

Read data from RFID tags attached to objects

5.0 DATA TRANSMISSION

AGV DATA TRANSMISSION

Wired communication

- Connected to a central control system using wires, such as Ethernet cables or serial communication cables
- Used in situations where the AGVs operate in a fixed area, such as a factory or warehouse

Wireless communication

- Wi-Fi or Bluetooth, to transmit data to a central control system
- Useful when the AGVs operate in a larger area, such as a distribution center or outdoor facility

Laser guidance

- Use laser guidance systems to navigate their environment
- Scan the AGV's surroundings and transmit data about its location and orientation to a central control system
- Useful for AGVs that operate in environments with complex layouts or obstacles

RFID

- Use RFID technology to transmit data about their location and status
- RFID tags are placed at key locations in the AGV's environment, and the AGV's on-board RFID reader scans the tags and transmits the data to a central control system

AMR DATA TRANSMISSION

Wireless communication

- Wi-Fi, Bluetooth, or cellular networks to transmit data to a central control system
- Useful when the AMRs operate in a larger area, such as a warehouse or distribution center

Optical communication

- Use infrared or visible light to transmit data to a receiver, which then relays the data to a central control system
- Useful for AMRs that operate in environments with electromagnetic interference, such as factories

RFID

- Use RFID technology to transmit data about their location and status

LiDAR

- Use LiDAR technology to transmit data about their surroundings
- LiDAR sensors emit laser beams that bounce off objects in the environment and create a 3D map of the surroundings. The AMR's on-board computer processes this data and uses it to navigate the environment

6.0 POWER MANAGEMENT

AGV & AMR POWER MANAGEMENT

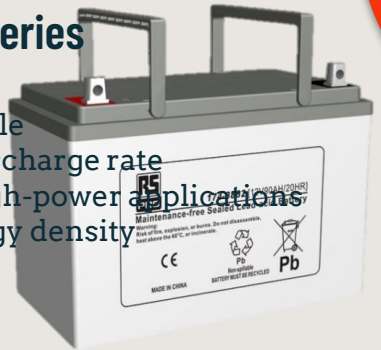
Lithium-Ion (Li-ion) Batteries

- ✓ Have high energy density
- ✓ Have a longer lifespan
- ✓ Lightweight
- ✓ Have a low self-discharge rate
- X Expensive

Nickel-Metal Hydride (NiMH) Batteries

- ✓ Similar to Li-ion batteries in terms of their energy density
- ✓ Less expensive
- ✓ Less prone to overheating or catching fire
- ✓ Have a longer lifespan than lead-acid batteries

Lead-Acid Batteries



- ✓ Inexpensive
- ✓ Widely available
- ✓ Have a high discharge rate
- ✓ Suitable for high-power applications
- X Have low energy density

Solid-State Batteries

- ✓ New technology uses solid electrolytes instead of liquid electrolytes
- ✓ Have high energy density than Li-ion batteries, are safer, and have a longer lifespan

05

AGV & AMR COMPANIES IN MALAYSIA

AGV & AMR COMPANIES IN MALAYSIA

1. eMooVit https://www.emoovit.ai/about/
2. df Automation & Robotics https://www.dfautomation.com/about-us
3. Ideasparq https://www.ideasparq.com/internships
4. MOVE Robotic https://www.moverobotic.com/

Services/Reseller:

1. Robopreneur https://www.robopreneur.com/
2. Cyber Solution https://cybersolution.com.my/products/
3. Klenco https://www.klenco-asia.com/contact-us/

05

CONCLUSION

CONCLUSION

- AGVs (Automated Guided Vehicles) and AMRs (Autonomous Mobile Robots) are both types of robots that are used in industrial automation and material handling applications.
- AMRs are more flexible and versatile than AGVs, as they can navigate around obstacles and adapt to changing environments. They are also easier to integrate into existing facilities and do not require any infrastructure changes. However, they are typically slower and have a lower payload capacity than AGVs.
- AGVs, on the other hand, are faster and have a higher payload capacity than AMRs. They also have a lower upfront cost, making them a more cost-effective solution for larger material handling operations. However, they require infrastructure changes and can be less flexible than AMRs in adapting to changes in the environment.
- Both AMRs and AGVs can help to improve efficiency, reduce costs, and increase safety in industrial automation and material handling applications. The choice between the two depends on the specific needs and requirements of the application.

THANK YOU