AGV/AMR

ROBOTIC HARDWARE SYSTEM

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HISTORY

AGV

THE FIRST AUTOMATED GUIDED VEHICLE, WHICH WAS JUST A GLORIFIED TOW TRUCK WHEN IT INITIALLY APPEARED IN THE EARLY 1950S, COULD NAVIGATE WITHOUT A DRIVER OR A PERMANENT RAIL SYSTEM BY SIMPLY FOLLOWING A TRACK OF WIRES BURIED ON THE FACTORY FLOOR THAT PRODUCED A MAGNETIC FIELD.

AMR

THE ORIGINAL AMR WAS CREATED BY WILLIAM GREY WALTER IN THE LATE 1940S AND EARLY 1950S. ELMER AND ELSIE WERE TWO OF HIS SUCCESSFUL PROTOTYPES. HE USED THE ROBOTS IN HIS RESEARCH TO DEVELOP NEUROPHYSIOLOGY. TO REPRESENT TWO INTERCONNECTED NEURONS, THEY USED A VACUUM TUBE-EQUIPPED BUMP SENSOR AND A LIGHT SENSOR.

APPLICATIONS OF AGV/AMR

Warehouse/manufacturing facility

- Widely used in material handling in moving one materials from one location to another location.
- Also used in inventory management such as inventory counting, restocking and picking object on the shelves asthey could navigate through the shelves

Healthcare

- Used to transport medical equipment, medications and food supply to different areas in hospital and healthcare facilities
- Reducing the contamination and improving patient care.

Retail/Restaurants

- Used to transport food, drink or also other items to the customer's table or homes.

Agricuture & Farming

- Material handling and transportation in agricultural and farming activities are being automated to increase efficiency and cut labour expenses.

DIFFERENCES OF AGV & AMR

AGV

- Requires tracks
- Obstacles will stop it
- Difficult to re-map
- Needs depots
- Does not deliver to user
- Travels in dedicated area
- Difficult to expand
- Some case, cheaper
- Simpler than AMR

AMR

- Trackless navigation
- Can fo around obstacles
- Easily re-mapped
- No depots needed
- Delivers to user location
- Travels around people
- Easy to change & expand
- More expensive than AGV
- Complicated compared to AGV

ROBOT BODY DESIGN AGV

Forklift	Pallets can be lifted and moved using a forklift attachment that is attached to them. They are employed to autonomously stack and transport things like automobiles, coils of paper, and even rolls of paper.
Carts	the most basic AGV material handlers. These are low-profile carts with a mounted storage unit that holds a variety of goods or items. When the necessary resources are needed, it stops moving around the building.
Unit-Load	Transporting individual things automatically. It can load items with a lot of surface area, such a pallet or a bin of goods.
Heavy-haul	The most durable kind, with heavy-duty bases, wheels, and platforms, and designed to support up to 250,000 pounds. They are made to transport massive machinery, big cars, and other bulky machinery.
Towing	Similar to carts, towing AGVs have a tow bar that can be used to tow other containers or carts that are not powered.

ROBOT BODY DESIGN AMR

BOX SHAPE

THE BODY OF THE ROBOT CAN RESEMBLE A BOX WITH FLAT SIDES AND AN EASILY OPENABLE TOP COVER. THE ROBOT CAN MOVE VARIOUS MEDICAL SUPPLIES IN THE FORM OF BOXES, TRAYS, AND BINS THANKS TO ITS DESIGN, WHICH ALSO MAKES IT SIMPLE TO LOAD AND UNLOAD THE SUPPLIES.

CYLINDRICAL SHAPE

THIS BODY STYLE IS APPROPRIATE FOR AMRS WHO MUST MANOEUVRE THROUGH CONSTRAINED PLACES OR DENSELY POPULATED AREAS. THE ROBOT CAN MOVE AROUND AND AVOID OBSTACLES WITHOUT BECOMING STUCK BECAUSE TO ITS CYLINDRICAL DESIGN. HOSPITALS AND RESTAURANTS FREQUENTLY UTILISE THIS SORT OF AMR.

MODULAR DESIGN

THE ROBOT CAN FEATURE A MODULAR ARCHITECTURE THAT ENABLES EASY MAINTENANCE AND REPAIR AS WELL AS CUSTOMIZATION FOR VARIOUS MEDICAL SUPPLIES.

COMPACTSIZE

THE ROBOT SHOULD BE SMALL ENOUGH TO FIT THROUGH LIFT DOORS AND THE NARROW HOSPITAL HALLWAYS AND CORRIDORS WITHOUT DIFFICULTY.

LOW PROFILE

IN ORDER TO OFFER STABILITY AND LOWER THE CHANCE OF TOPPLING OVER WHEN CARRYING A BIG LOAD, THE ROBOT'S BODY SHOULD BE LOW TO THE GROUND.

LOCOMOTION

OMNI-DIRECTIONAL WHEEL

- *Allow them to move without turning, in any direction.*

RUBBER WHEEL

- *Ideal for flat surfaces like floors made of linoleum or concrete*

METAL WHEEL

- *More suitable for abrasive areas like gravel or dirt*

MECANUM WHEEL

- *The wheel's rim has numerous small rollers positioned at an angle that permits movement in any direction.*

NAVIGATION SYSTEM & CONTROLLER (AGV)

1 MAGNETIC LINE NAVIGATION

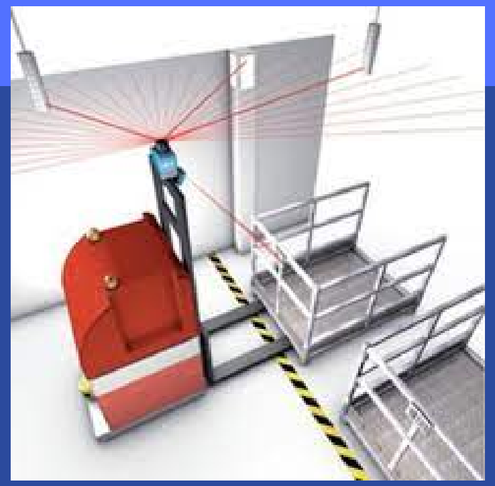
- Clearly marked on the floor by using reflective colour or magnetic line
- Magnetic sensor will follow the line

2 DATA MATRIX NAVIGATION

AGV will move between points while detecting the code to determine its precise whereabouts at any given time. For the robot to move in the right directions, the sensor must be as precise as possible.

3 LASER NAVIGATION

Found reflector markings using a 360° horizontal 2D environment-sensing LiDAR scanner. The robot's onboard computer makes calculations to determine its orientation and location. After that, the robot moves about the area using this information.



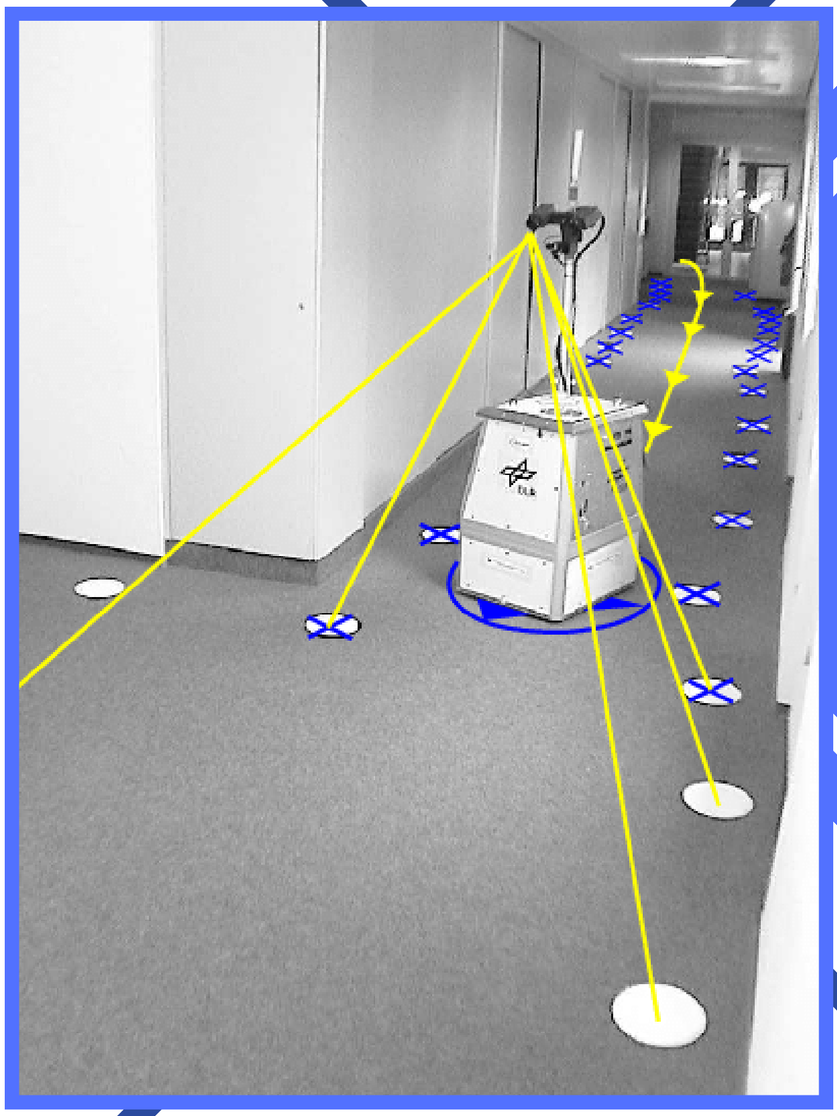
NAVIGATION SYSTEM & CONTROLLER (AMR)

AMR

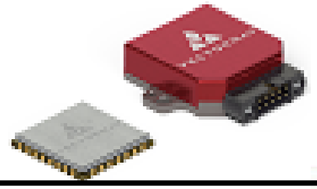
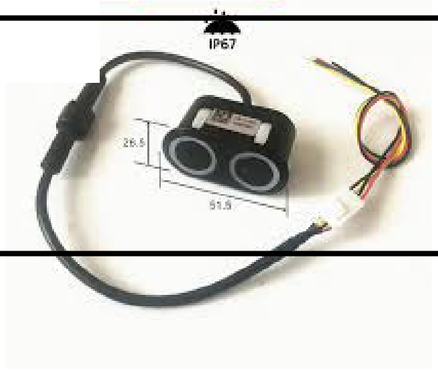
- MOVE THROUGH CHANGING INFRASTRUCTURE
- RELY ON NATURAL LANDMARKS FOR LOCALIZATION & ENVIRONMENTAL DETECTION
- EQUIPPED WITH CAMERAS, LIDAR & ULTRASONIC SENSOR TO HELP IN DETECTING SURROUNDINGS
- USING **SLAM** TECNIQUES

SLAM (SIMULTANEOUS LOCALIZATION AND MAPPING)

- MAKING MAPS OF THE SURROUNDING AREA AND FINDING OWN AND OTHERS POSITION ON THE MAP
- THE MAP IS CONSTANTLY UPDATED AND REFINED AS THE ROBOT MOVES AROUND THE SURROUNDINGS.



SENSORS FOR AGV/AMR

Camera	The camera captures photographs of the surroundings that may be used to generate a map, and it can also follow visual elements to establish the robot's position.	
LiDar	Used in mapping, localisation, and obstacle detection. Create a 3D map of the robot's surroundings by emitting laser beams and capturing their reflections while knowing the distances.	
Inertial Measurement Unit (IMU)	Calculate the robot's spin and acceleration. They are frequently used in conjunction with other sensors to increase localisation accuracy, such as lidar and cameras.	
Ultrasonic Sensors	Sound waves can be used to identify obstructions in the robot's route. They are frequently employed for detecting close-range obstacles.	

DATA COLLECTION

Inventory Management

- fitted with scanners or sensors to collect data on inventory levels and item placement. They may walk around warehouse aisles and scan barcodes or RFID tags to track merchandise in real time.

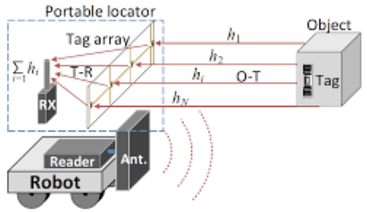
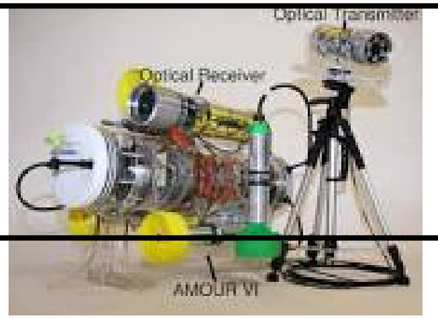
Environmental monitoring

- can be used to gather information on environmental variables such as temperature, humidity, and air quality. They can roam about and collect readings using temperature and humidity sensors.

Quality Control

- AGV and AMR might aid in inspecting the quality of things in warehouses by employing cameras, lidar sensors, and other sensors to collect data on faults or damaged items to be recorded in the system, and then warehouse workers could take the items and replace them with new ones.

DATA TRANSMISSION

Wired Communication	This approach includes the use of physical cables to transfer data between system components. Ethernet cables, RS-232 or RS-485 serial connections, or other sorts of wired connections can be used for this.	
Wireless Communication	Data is sent over a wireless network, such as Wi-Fi or Bluetooth. Because robots and other system components do not need to be physically linked by cables, this provides for greater freedom in their placement.	
RFID	RFID tags and readers are used to communicate data between the robots and other system components. RFID tags can be connected to robots, goods, or other things, and readers can be strategically positioned around the facility to track and communicate data.	
Optical	The use of infrared or laser-based communication to send data between robots and other system components. This can be beneficial in circumstances where there is a risk of radio frequency interference or when high levels of security are required.	
Cellular	Cellular networks are used to transport data between the robots and other system components in this manner. This can be beneficial for AGV/AMR systems deployed across broad regions or in distant places.	

POWER SYSTEM MANAGEMENT

LEAD ACID BATTERY

ADVANTAGE
- CHEAP
- LONG LIFESPAN

DISADVANTAGE
- HEAVY
- BULKY

LITHIUM-ION BATTERY

ADVANTAGE
- HIGH ENERGY DENSITY
- CHARGE QUICKLY

DISADVANTAGE
- EXPENSIVE THAN LEAD-ACID BATTERY
- SHORTER LIFESPAN

NICKEL-CADMIUM BATTERY

ADVANTAGE
- LONG LIFEPSAN
- CHARGE QUICKLY

DISADVANTAGE
- HEAVY
- EXPENSIVE

NICKEL-METAL HYDRIDE BATTERY

ADVANTAGE
- LIGHTWEIGHT
- LONG LIFESPAN

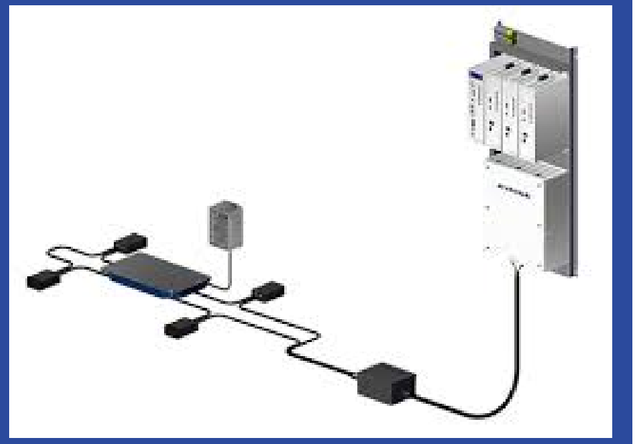
DISADVANTAGE
- EXPENSIVE THAN LEAD-ACID BATTERIES

CHARGING FOR AGV/AMR

CHARGING CONTACT

ADVANTAGE

- QUICK CHARGING
- SECURE CONNECTION
- LOW MAINTENANCE



DISADVANTAGES

- LIMITED RANGE
- POTENTIAL WEAR AND TEAR

WIRELESS

ADVANTAGE

- FLEXIBLE
- NO WEAR AND TEAR
- CONVENIENCE

DISADVANTAGS

- SLOWER CHARGING
- HIGHER COST
- INTERFERENCE