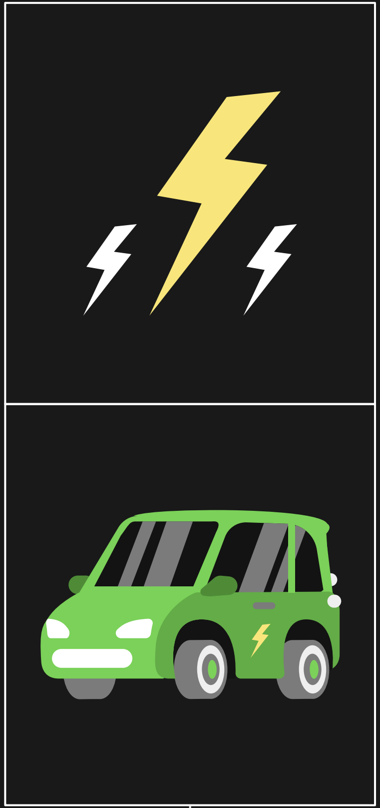
Automated Guided Vehicle/ Autonomous Mobile Robot



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01. INTRODUCTION

ABOUT AGV

- AGV stands for Automated Guided Vehicle.
- It is a computer-controlled, self-guided vehicles that used to transport materials, products or goods without human intervention.
- These vehicles are equipped with sensors and navigational tools that allows them to move safely and efficiently.
- Usually, we can found AGV in a warehouse, manufacturing facility or distribution center.

RESEARCH BACKGROUND ON AGV

- The first AGVs were developed and deployed in the automotive industry to transport raw materials and finished goods between different production lines.
- By 1980s, as technology has become more advanced, AGVs had become a common sight in manufacturing plants, warehouses and distribution centers.
- Early AGVs were limited to following a fixed path or using wires embedded in the floor to guide their movement.
- Recent research has allow AGVs to detect obstacles and adjust their path in real-time.

ABOUT AMR

- AMR stands for Autonomous Mobile Robot.
- AMR is same as AGV where it is capable of operating independently and moving around in a variety of environments without the need for human intervention.
- AMRs are equipped with sensors, cameras, and other navigational tools that allow them to map their surroundings, detect obstacles and hazards to plan the most efficient route to their destination.
- AMRs can be programmed to perform a wide range of tasks such as material handling, transportation, inspection and assembly.

RESEARCH BACKGROUND ON AMR

- Early research on AMRs focused on developing the fundamental concepts of mobile robotics, including navigation, obstacle avoidance, and mapping.
- Back then, AMRs were often controlled by human operators or followed pre-programmed paths.
- As technology has become more advanced, AMRs were developed to transport materials and product between production lines in manufacturing facilities.
- Recent research has focused on developing more intelligent and autonomous AMRs that can adapt to dynamic environment and perform a wider range of tasks.

02. HISTORY & APPLICATIONS

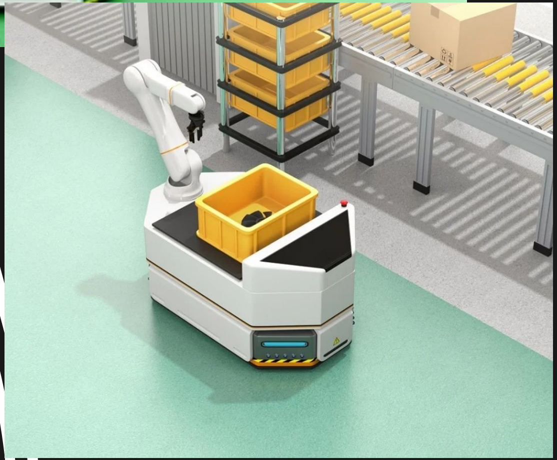
THE FIRST AGV

- The first AGV was developed in the early 1950s by Barrett Electronics Corporation, a company based in Northbrook, Illinois.
- This AGV was initially designed to transport materials in a grocery store warehouse.
- The 1st AGV was a tow tractor that could move along a wire embedded in the warehouse floor where the wire was used to guide the AGV along a pre-determined path.
- This AGV was powered by a 24-volt battery and was capable of towing a load up to 15K pounds.

THE FIRST AMR

- The first AMR was developed in late 1990s by a team of researchers at Carnegie Mellon University's Robotics Institute in Pittsburgh, Pennsylvania.
- It was called the "Gator" (General Autonomous Tasking of Robots), designed to perform a wide range of tasks in industrial and military environments.
- Equipped with a range of sensors, including cameras and laser range finders, that allowed it to navigate autonomously and avoid obstacles.
- The Gator was designed to be highly modular, allowing users to add or remove components depending on the specific task at hand.

APPLICATION



AGVs:

1. Material handling
2. Transportation
3. Assembly line feeding and uploading
4. Order picking and replenishment
5. Moving parts and components in production lines.
6. Moving equipment, supplies and medical waste.

AMRs:

1. Material handling and transportation
2. Logistics and e-commerce operations
3. Inspection and maintenance tasks
4. Medication and supply delivery
5. Patient transportation and disinfection

03. MAIN COMPONENTS

03. MAIN COMPONENTS

I. Frame & Design

II. Propulsion System

III. Navigation & Control System

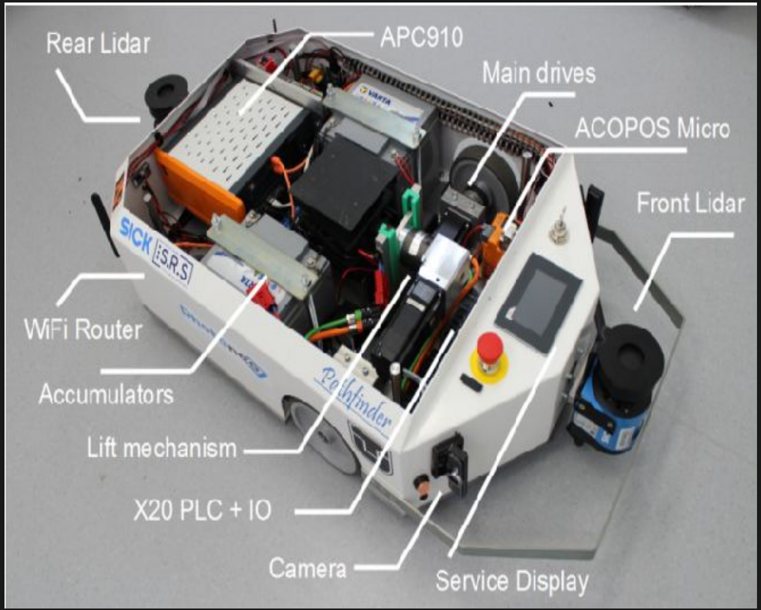
IV. Data Collection

V. Data Transmission

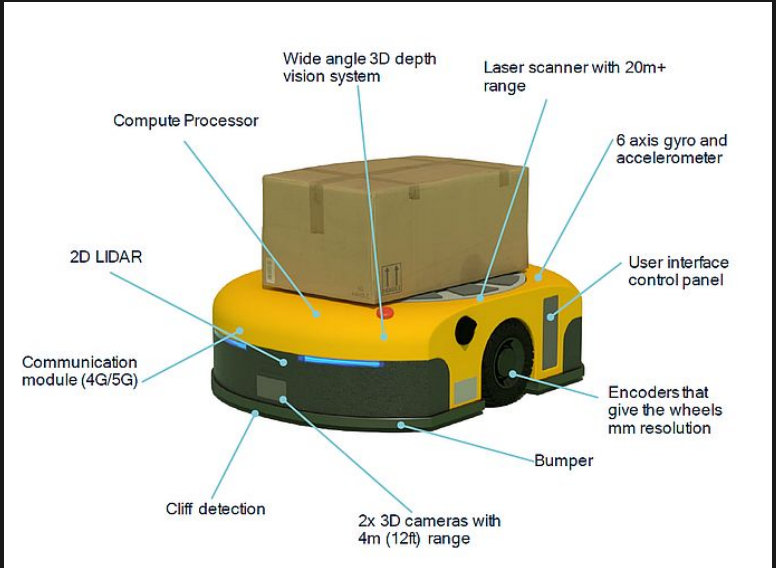
VI. Power Management

I. Frame & Design for AGVs

- Typically have a flat, rectangular frame that is low to the ground, with wheels or casters attached to the underside.
- The frame is designed to accommodate the load being transported which may be a pallet, a container or other.
- The material used for the frame are depending of the application and requirements of the vehicles. Aluminium, Steel, Carbon Fiber and Plastic are a common material used for the frame.



I. Frame & Design for AMRs



- AMRs have a more compact and versatile design that allows them to move around in confined space and navigate more complex environments.
- AMRs have variety of shapes and sizes depending on the application and environment.
- Some of shapes are cylindrical, box-like shape with wheels, tracks, or legs that allow them to move around obstacles.
- The material used for the frame of AMRs depend with the function of the vehicle but it is not limited to only Aluminium, Steel, Carbon fiber and plastic.

II. Propulsion System for AGV

Differential Drive

- AGVs use 2 drive wheels, which are controlled independently using motors.
- By varying the speed and direction of each wheel, it can move in any direction.

Omni-Differential Drive

- Use multi-directional wheels that enable the AGV to move in any direction, without needing to turn around.
- Allows the AGV to rotate around its axis while moving forward, backward or sideways.

II. Propulsion System for AGV

Magnetic Drive

- AGVs can use magnetic propulsion systems that use magnetic tape of markers placed on the floor to guide their movements.
- Magnetic sensors located on the AGVs can detect position and orientation of magnetic field.

Laser Guided Drive

- Use lasers to detect the position and orientation of reflective markers placed on the floor.
- Can follow a pre-programmed path based on the position and orientation of the markers.

II. Propulsion System for AMR

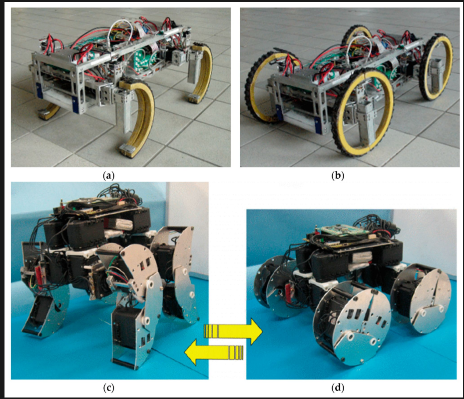
Wheel-Based Propulsion

- The robots moves on wheels driven by electric motors.
- The wheels may be omnidirectional, allowing the robot to move in any direction, or may be unidirectional, where the robot turns by moving its wheels in opposite direction.

Track-Based Propulsion

- The robot moves on tracks that are driven by electric motors.
- Well-suited for rough terrain and outdoor environments, where the robot needs to navigate over uneven surfaces.

II. Propulsion System for AMR



Legged Propulsion

- The robots moves on wheels driven by electric motors.
- The wheels may be omnidirectional, allowing the robot to move in any direction, or may be unidirectional, where the robot turns by moving its wheels in opposite direction.

Hybrid Propulsion

- The robot moves on tracks that are driven by electric motors.
- Well-suited for rough terrain and outdoor environments, where the robot needs to navigate over uneven surfaces.

III. Navigation & Control System for AGV

Magnetic Tape Navigation:

- A magnetic tape is placed on the floor of the facility to guide AGV. AGV is equipped with magnetic sensors that detect the magnetic field generated by the tape.

Laser Guidance:

- Uses lasers to guide the AGV's movement.
- Laser scanner mounted on the AGV emits a laser beam that bounces off reflectors placed on the facility walls, creating a map of the environment.

Inertial Navigation:

- AGV equipped with sensors that measure its acceleration, speed, and rotation.

Optical Navigation:

- Uses optical sensors to detect and follow pre-determined path marked on the floor.

Vision-Based:

- Uses cameras and computer vision to navigate AGV.
- The camera captures images of the environment, which are processed to create a map of surroundings.

III. Navigation & Control System for AGV

Central Control Unit:

- The brain of AGV's control system.
- Receives inputs from sensors and navigation system, processes data and send commands to propulsion system and actuators.

Sensors:

- Used to detect the AGV's position, orientation, surroundings.
- Magnetic, optical, laser or vision-based sensors.

Safety System:

- Used to prevent accidents and ensure safety.
- Includes emergency stop buttons, obstacle sensors and collision avoidance.

Communication System:

- Enables the AGV to exchange data with other machines.
- Use wired or wireless connections such as Ethernet, CAN bus, or Wi-Fi.

III. Navigation & Control System for AMR

SLAM:

- Uses sensors such as lidar, cameras or sonar to create a map of the environment and simultaneously determine the robot's position within that map.
- Map is updated as the robot moves.

Magnetic Guidance:

- A magnetic tape is placed on the floor of the facility to guide AMR. AMR is equipped with magnetic sensors that detect the magnetic field generated by the tape.

Inertial Navigation:

- AMR equipped with sensors that measure its acceleration, speed, and rotation.

Ultrasonic Navigation:

- Use Ultrasonic sensors to detect obstacles and map the environment.

Vision-Based:

- Uses cameras and computer vision to navigate AMR.
- The camera captures images of the environment, which are processed to create a map of surroundings.

III. Navigation & Control System for AMR

Central Processing Unit:

- Main control unit of AMR.
- Receives inputs from sensors and navigation system, processes theh data, and send commands to the propulsion systems and actuators.

Sensors:

- Used to detect the AMR's position, orientation, surroundings.
- Lidar, cameras, sonar, or ultrasonic sensors.

Safety System:

- Used to prevent accidents and ensure safety.
- Includes emergency stop buttons, obstacle sensors and collision avoidance.

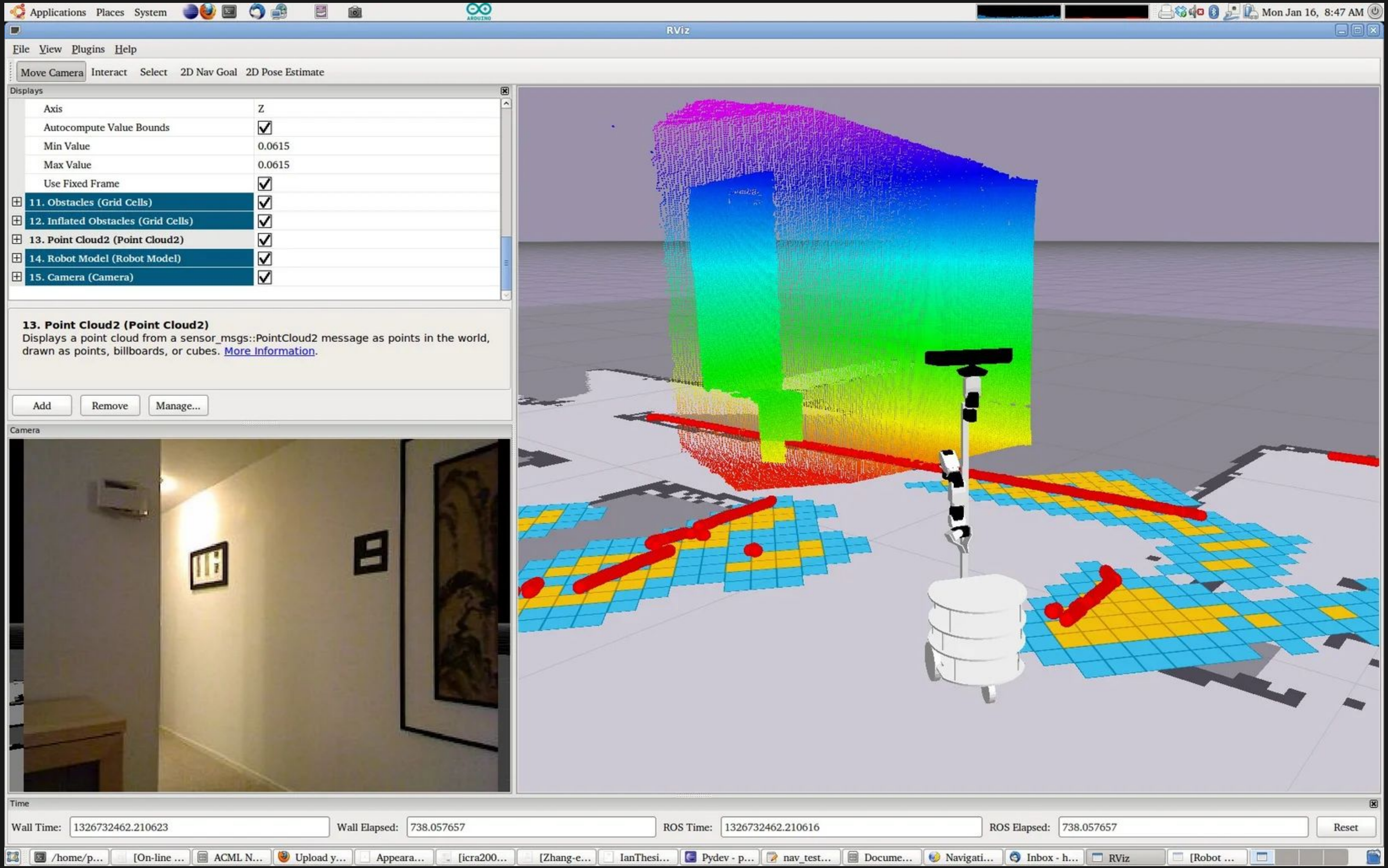
Communication System:

- Use wired or wireless connections such as Ethernet, CAN bus, or Wi-Fi.

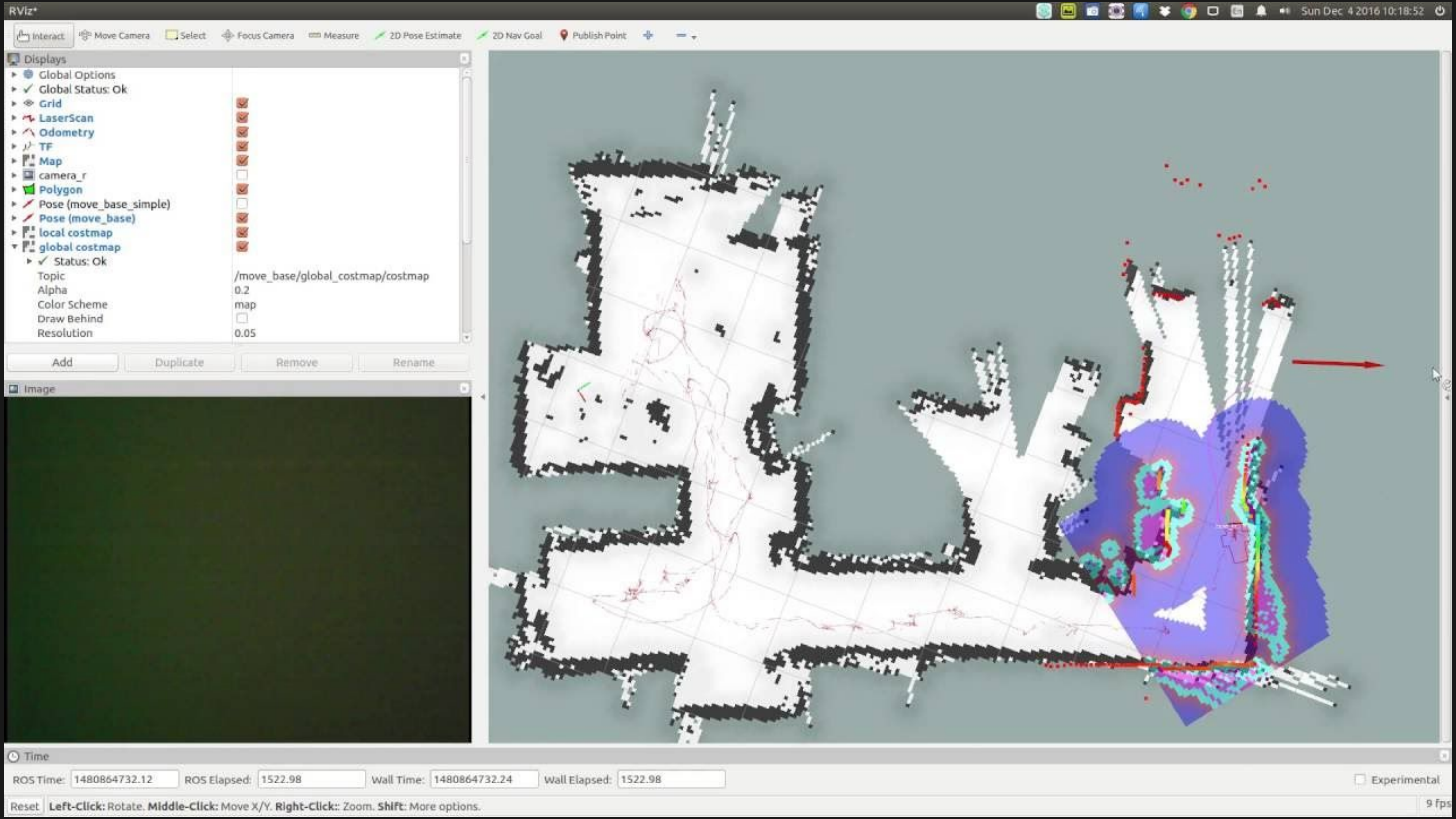
Actuators:

- Grippers or arms can be used to pick up and manipulate objects.

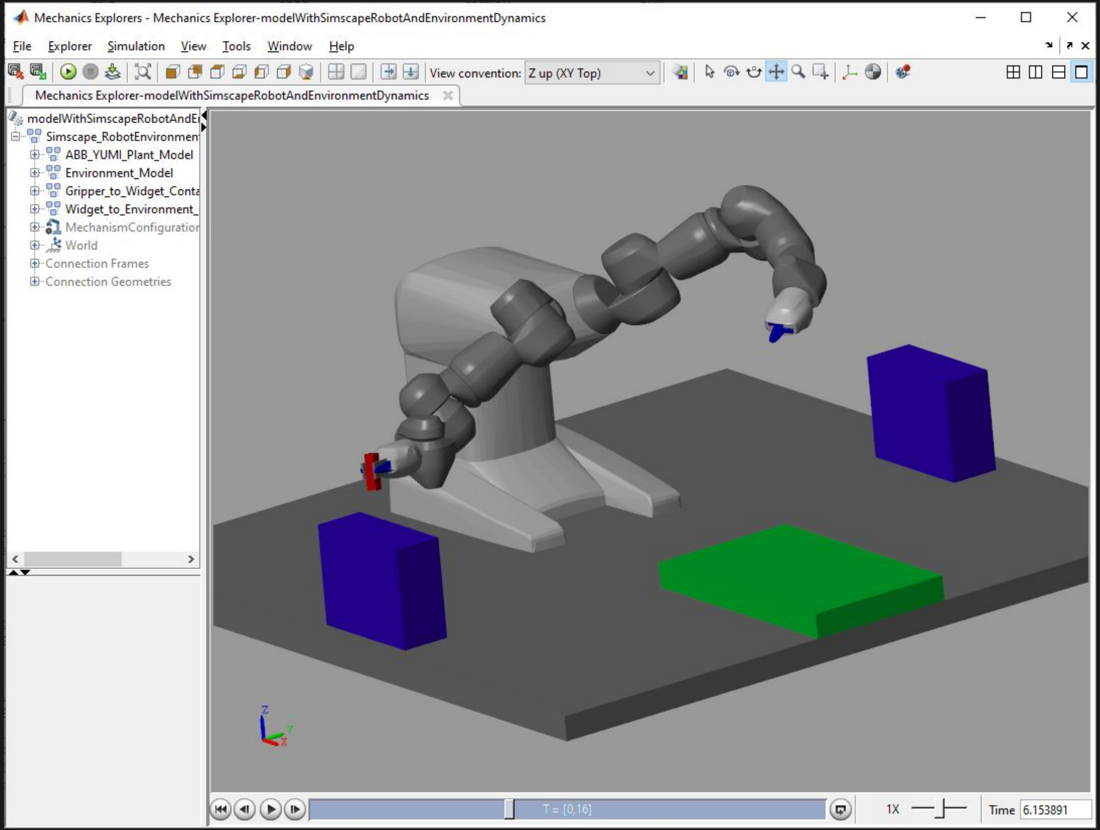
NAVIGATION SOFTWARE (ROS)



NAVIGATION SOFTWARE (SLAM)



NAVIGATION SOFTWARE (MATLAB)



NAVIGATION SOFTWARE (AGV Fleet Management Systems)

IV. Data Collection

Sensors:

1. Lidar
2. Camera
3. Sonar/ Ultrasonic Sensor
4. Infrared Sensor
5. Encoders
6. GPS

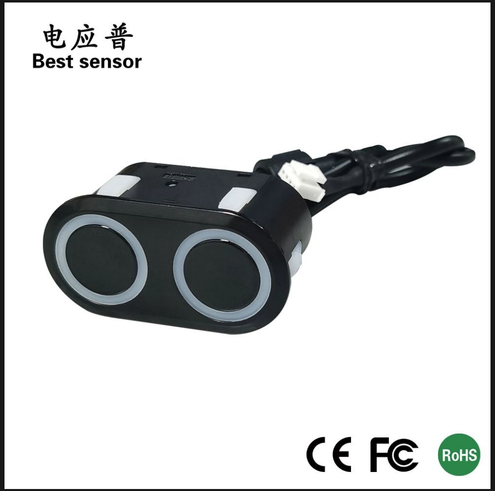
Actuators:

1. Electric Motors
2. Pneumatic Cylinders
3. Gripper or arms
4. Conveyor Belts
5. Vacuum Suction Cups

LIDAR:

CAMERAS:

SONAR:



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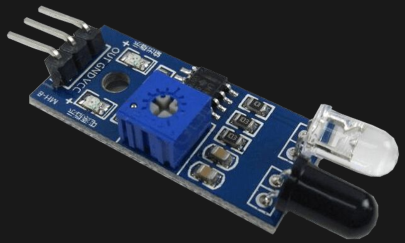


ENCODERS:

GPS:

Electric Motors:

Pneumatic Cylinders:

Gripper:

Conveyor Belts:

Vacuum Suction Cups:

V. Data Transmission

Wireless Communication:

- Both AMR and AGV often use wireless communication protocols such as Wi-Fi, Bluetooth, or ZigBee to transmit data between the robot and its control system or other devices.

Wired Communication:

- AGVs may be tethered to their control system or other devices using cables.

CAN Bus Communication:

- A communication protocol commonly used in automotive and industrial application.
- Used to connect sensors, actuators, and other devices in an AGV or AMR.

Ethernet Communication:

- Often used to connect AGVs and other automation equipment to the factory network.
- Provides a high-speed and reliable connection, allowing for real-time data transfer and control.

VI. Power Management

Battery System:

- Rechargeable battery systems is used to power the robot.
- These batteries ranges from small low-voltage batteries to large, high-high voltage battery packs.

Charging System:

- The battery must be charged regularly to keep AGV or AMR running.
- Include simple charging contacts or more complex charging stations that use sensor and communication protocols to optimize charging.

Energy Recovery System:

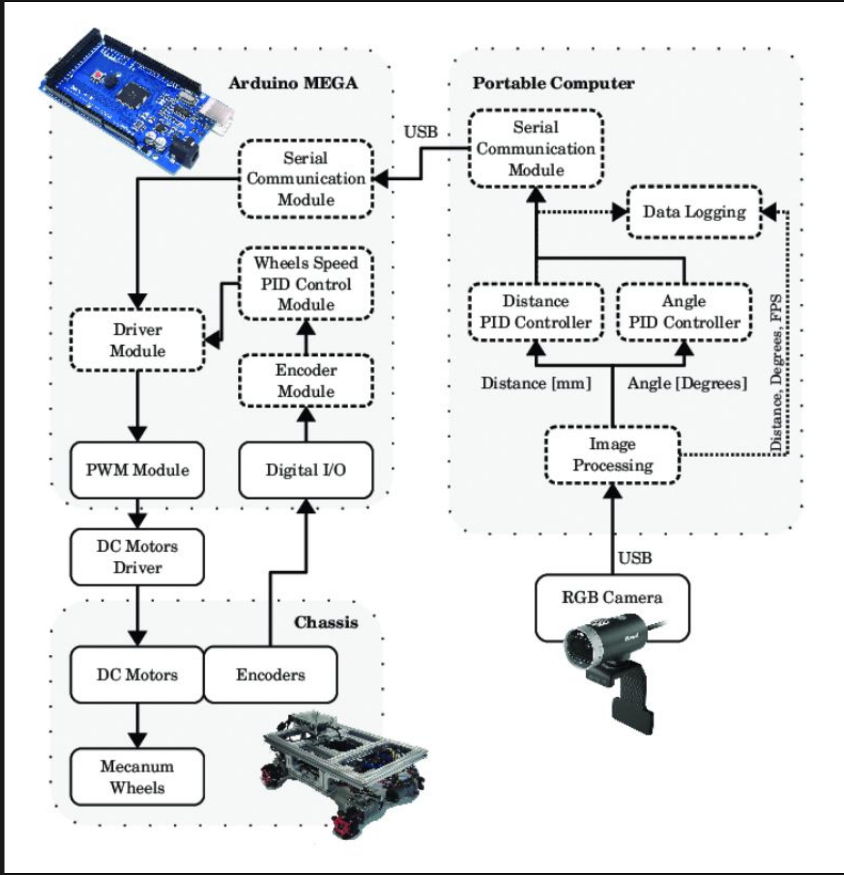
- Help extend the runtime of AGVs and AMRs by capturing and reusing energy.
- For example, regenerative braking can capture energy during deceleration and use it to recharge battery.

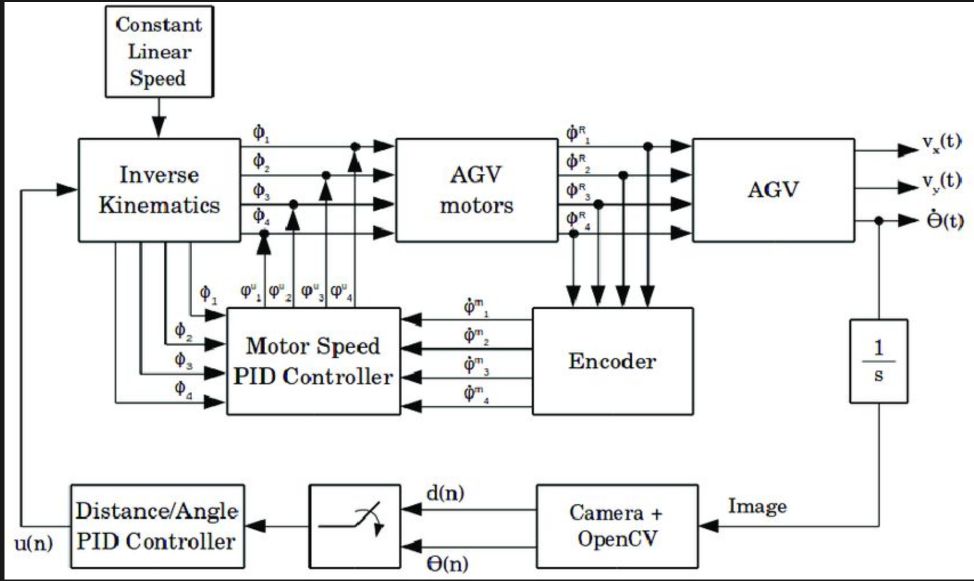
Power Distribution System:

- Distribute power from the battery system to the various motors, sensors, and other components in AGV or AMR.
- These include voltage regulators, fuses, and circuit breakers to ensure safe and efficient operation.

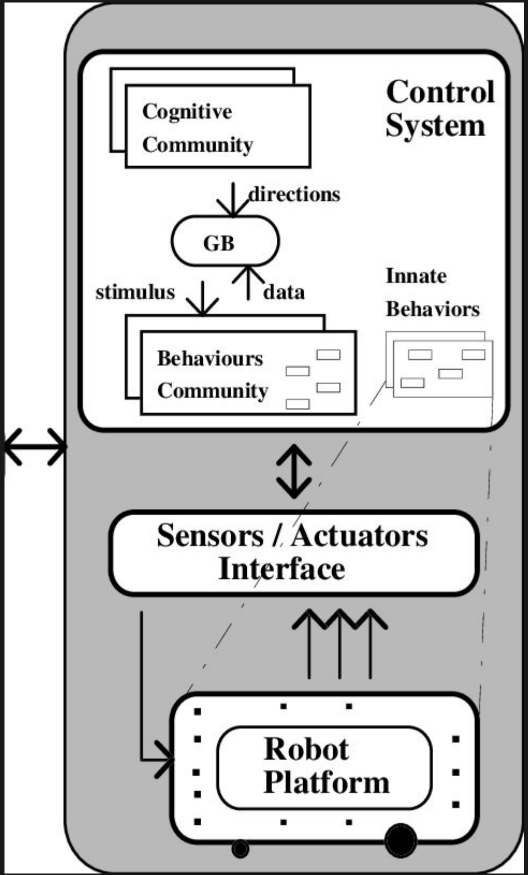
04. BUILDING YOUR OWN

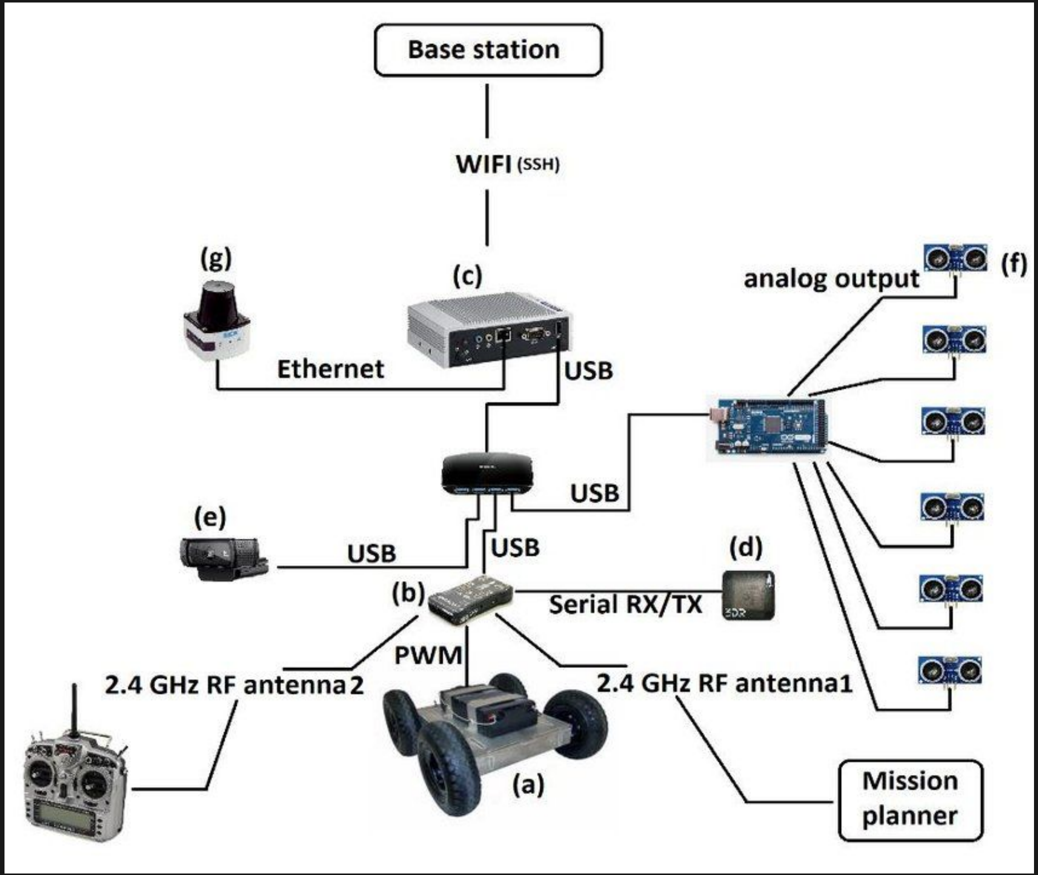
Complete AGV System Architecture



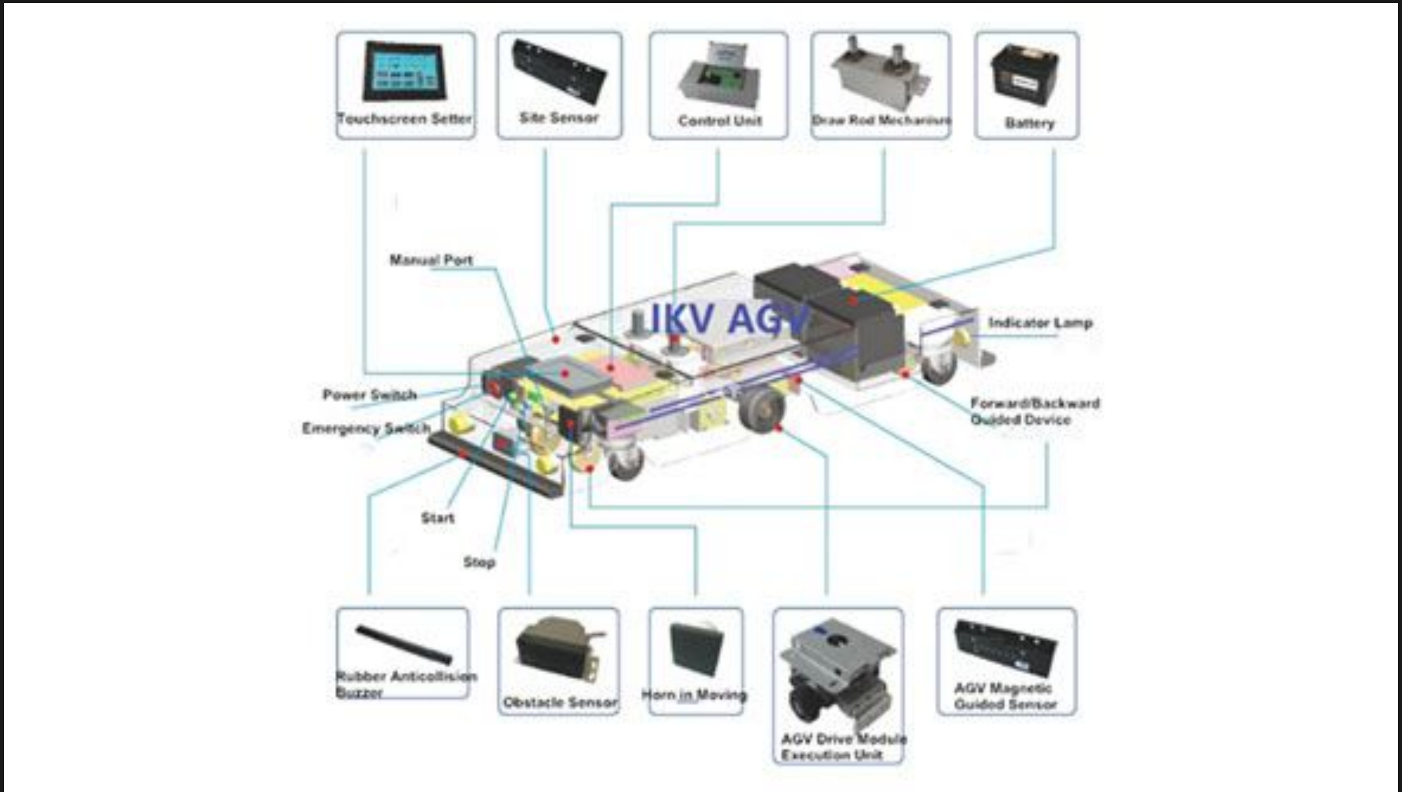


Complete AMR System Architecture

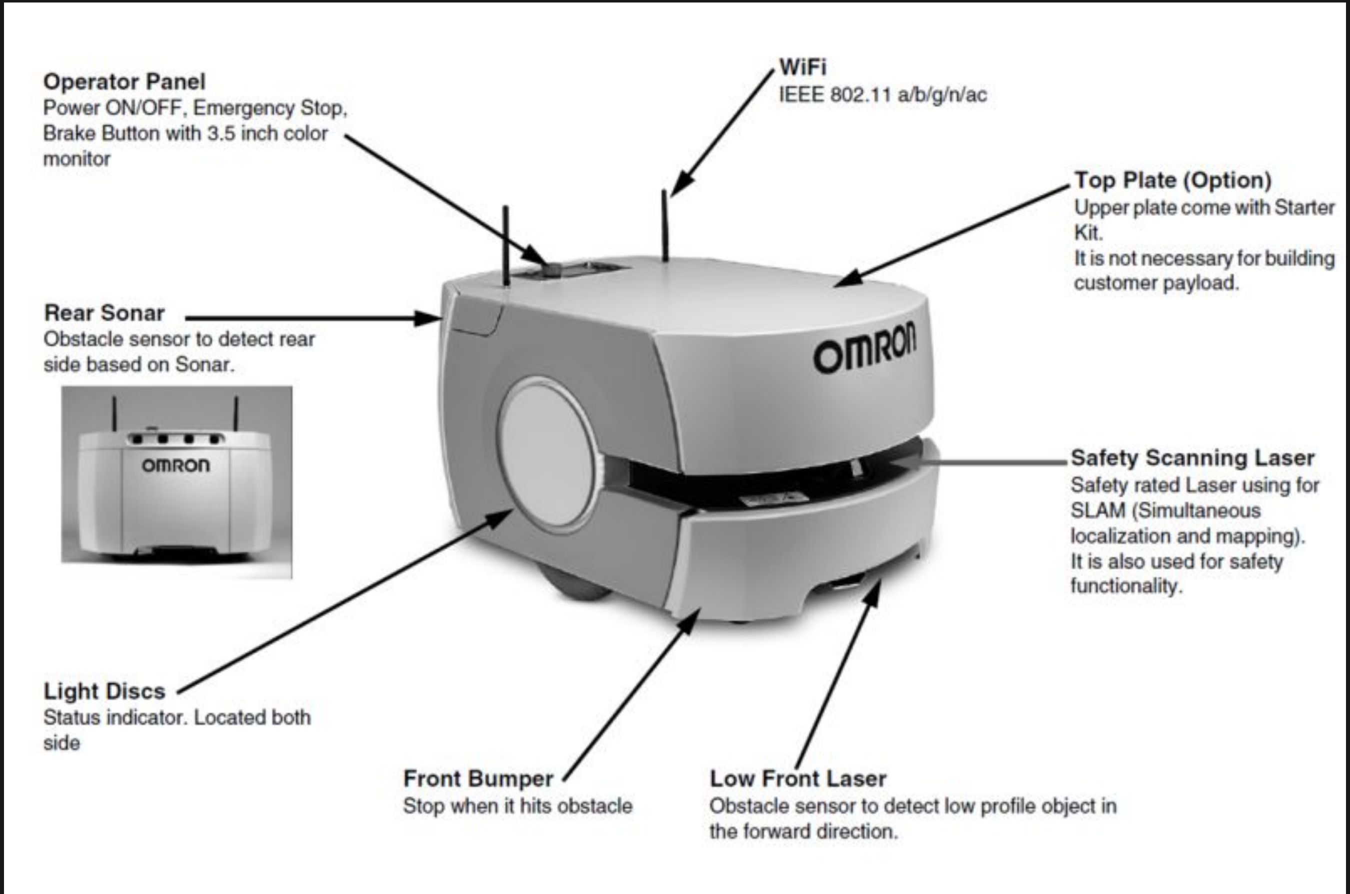




AGV Hands On Session



AMR Hands On Session

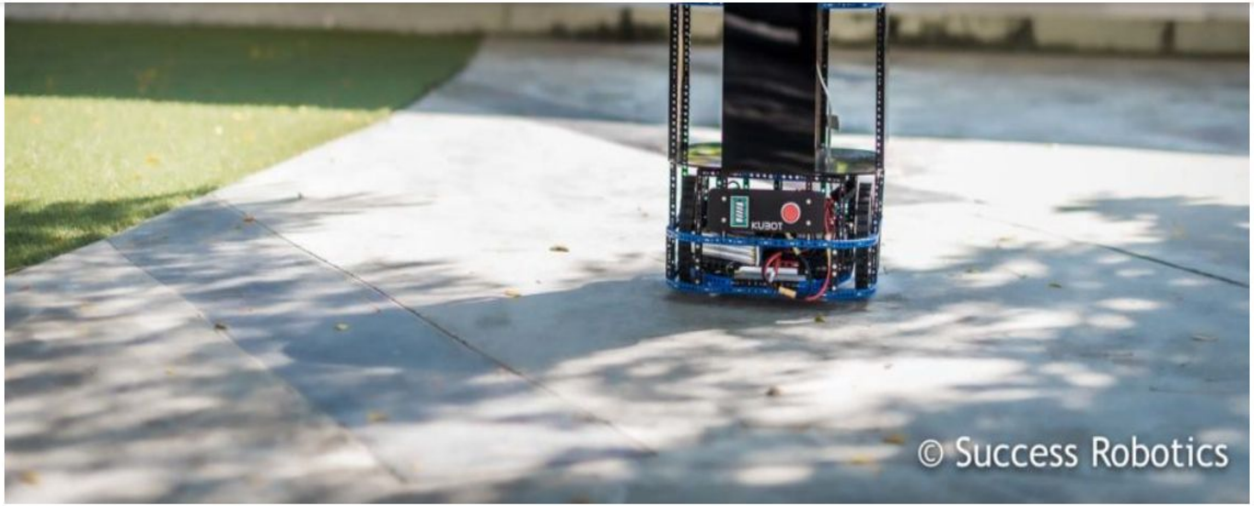


Robotic Competitions

The Robotic Competitions are part of the vision of creating "Robot Sports Arena" events. We envision that student teams will develop their own robotic systems in order to compete in certain races and challenges challenging the limits of robotic design and autonomy technologies.

2017 Robotic Competition

For the 1st robotic competition (Spring 2017), students will compete on an autonomous car racing challenge. Inside the Autonomous Robots Arena, a mock-up environment of a race track will be made and student teams will have to develop their own robotic car solution.



Categories

News

Automated Guided Vehicle Robot : AGV Competition Rules for Vocational & High Vocational – Version 1

23 November 2019 | by PR in News

Automated Guided Vehicle Robot : AGV Competition Rules for Vocational & High Vocational – Version 1 can be downloaded below.

https://drive.google.com/drive/folders/1mt-y8Rl3k1enZ90yJnZCrRyoRSihJOXr

05. MALAYSIA MARKET

MARKET PLAYER FOR AGV AND AMR

1. Daifuku Malaysia
2. FMC Technologies Malaysia
3. LKL Advance Metaltech
4. FlexMove System (M) Sdn Bhd
5. ST Engineering
6. Omron Malaysia
7. ABB Malaysia
8. MiR Asia
9. Kollmorgen Malaysia
10. Zebra Technologies Malaysia
11. Prostrain

WHO CAN USE AGV AND AMR IN MALAYSIA ?

1. Researchers
2. Manufacturing companies
3. Warehousing and distribution companies
4. Automotive industry
5. Healthcare industry
6. Food and beverage industry
7. Retail industry
8. Intel Malaysia
9. Panasonic Malaysia
10. Lazada Malaysia
11. Petronas
12. Top Glove
13. Proton
14. Ceva Logistics
15. Shopee Malaysia

Obstacles

Cost:

- Initial investment in AGVs and AMRs can be expensive, especially for smaller companies.

Technical Expertise:

- Implementing AGVs and AMRs requires technical expertise in robotics, automation, and software programming.
- Finding candidates with right talent and skills might be challenging.

Safety Concerns:

- AGVs and AMRs operate autonomously, which means they must be programmed and designed to avoid collisions with humans and objects.

Infrastructure Limitations:

- AGVs and AMRs require a stable reliable wireless network for communication and data transfer.
- In some areas, internet infrastructure may not be robust enough to support these systems.

Top things to remember operating AGV & AMR

Safety First:

- AGVs and AMRs should be designed and programmed with safety in mind.

Maintenance:

- Regular maintenance is essential to keep AGVs and AMRs operating smoothly.

Training:

- Employees who work with AGVs and AMRs should receive proper training on how to operate and interact with the systems safely.

Data Management:

- AGVs and AMRs generate significant amount of data, including performance metrics and sensor reading. It is important to have a plan for collecting, storing and analyzing data.

Battery Management:

- AGVs and AMRs are powered by batteries.
- Therefore, it is essential to manage the battery life to ensure the systems operate as expected.
- This includes monitoring the battery levels, charing the batteries regularly, and replacing them when necessary.

06. CONCLUSION

Conclusion

In conclusion, AGVs and AMRs are robotic systems used in industries to improve efficiency and safety. AGVs follow a predetermined path using sensors, while AMRs are autonomous robots that navigate using various technologies. They reduce manual labor, improve safety, and increase efficiency in various applications. Their implementation requires a significant investment, but it can be worthwhile. AGVs and AMRs are becoming more popular in Malaysia and other countries as companies seek to optimize operations and stay competitive.