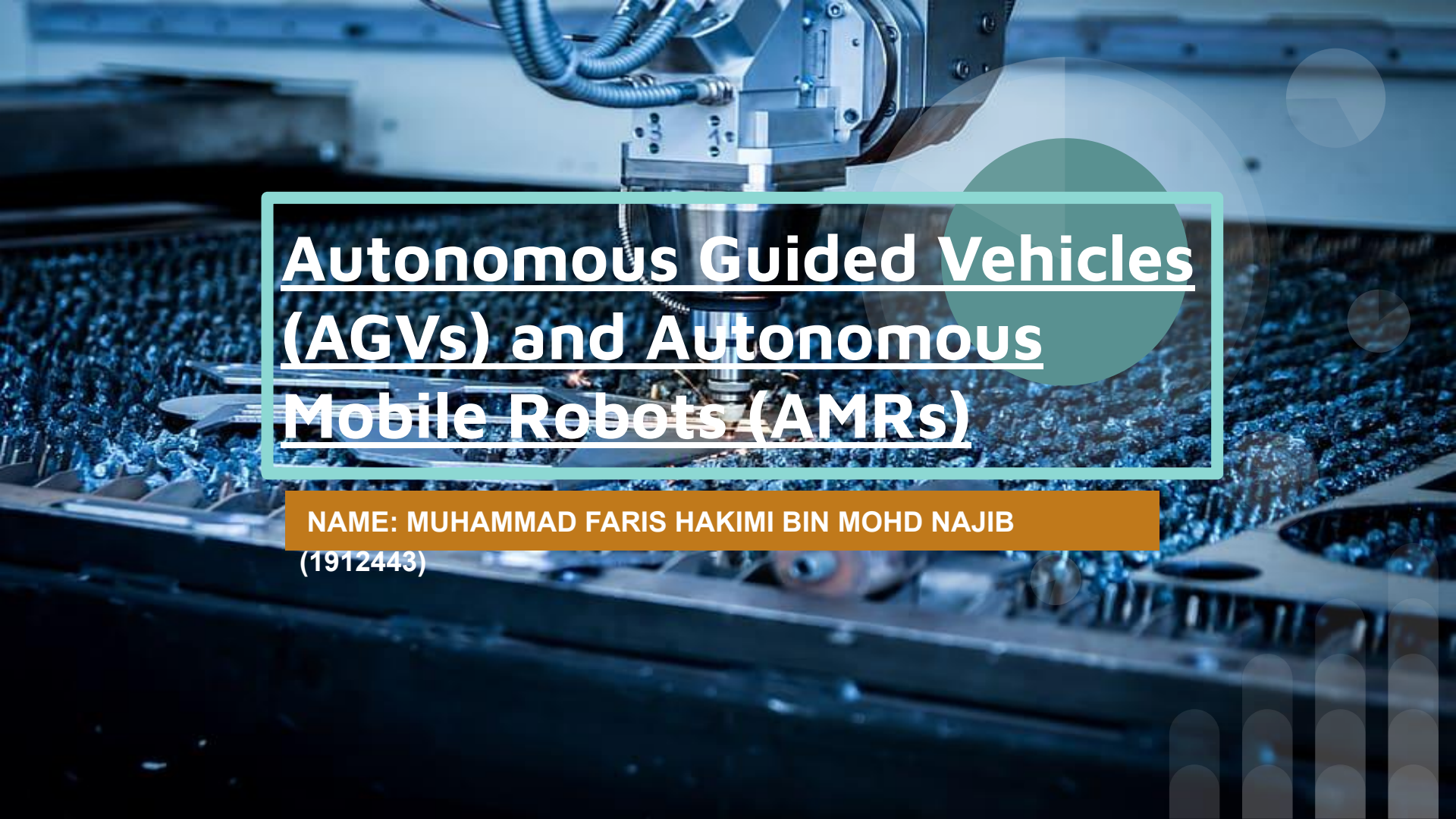


Autonomous Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs)

NAME: MUHAMMAD FARIS HAKIMI BIN MOHD NAJIB (1912443)

INTRODUCTION

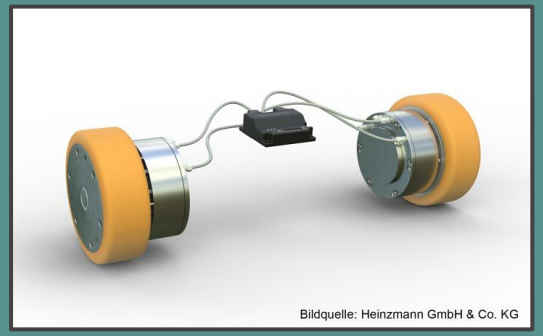
- AGV (Automated Guided Vehicle) and AMR (Autonomous Mobile Robot) are two types of autonomous mobile devices that are used to transport materials and goods within industrial environments. Both AGVs and AMRs are designed to navigate autonomously, without requiring any human intervention.

- The main difference between an AGV and an AMR is that AMRs use free navigation by means of lasers, while AGVs are located with fixed elements: magnetic tapes, magnets, beacons. So, to be effective, they must have a predictable route.

Main components

1. Locomotion
2. Control System
3. Data Collection
4. Data Transmission
5. Actuation Hardware
6. Power Management

LOCOMOTION (AGV/AMR)



Compact drive system for AGVs

3A Series Magnetic Navigation AGV

- Wheels are used for movement on smooth and flat surfaces

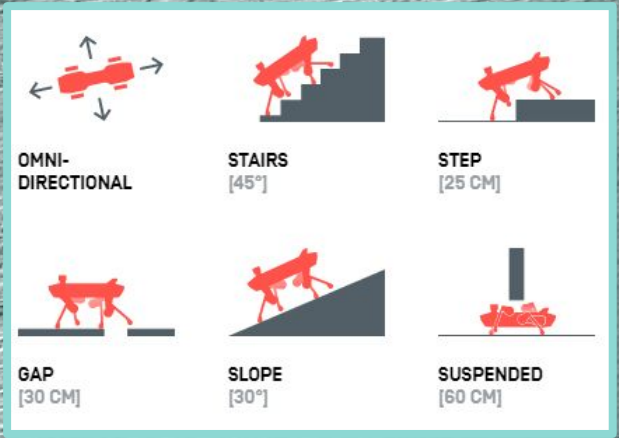
Bipedal robot

SPECS

Degrees of freedom (DOF)
6
Weight
1.9
kg (body)
Servo's per leg
6
XM430-W350-R
XM430-W210-R
Center of mass
38
mm
Manufacturing technique
3D printing (ABS)

➔ The robot has a leg mechanism that achieves 6 DOF with a combined structure of serial and parallel mechanism. It is designed to have a light structural inertia and large workspace for agile bipedal locomotion.

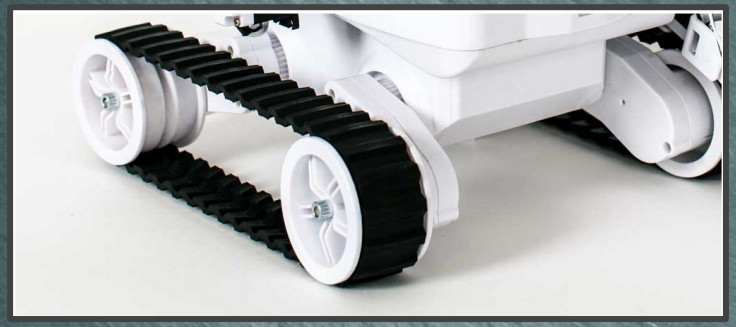
QUADRUPED ROBOT



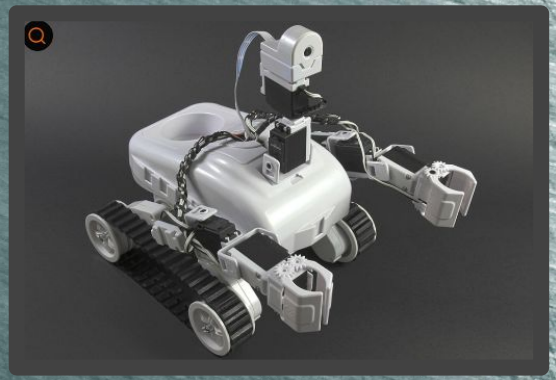
ANYmal's legs provide unparalleled mobility when moving up and down stairs, climbing over obstacles, steps, and gaps, and crawling into tight spaces. It delivers reliable performance in harsh indoor and outdoor environments and through rain, splash water, wind, snow, and dust.

ANYbotic ANYmal

TRACKED ROBOT



➔ This robot is designed to travel long distances and through difficult territory. Compared to wheels, treads allow travel across a wide variety of surfaces without getting stuck.



ROLI - TRACKED ROBOT

CONTROL SYSTEM

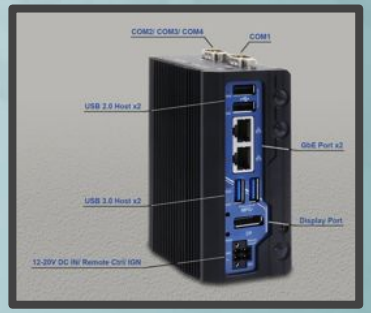
MICROPROCESSORS

FUNCTIONS ➡ TO PROCESS SENSORY INFORMATION AND MAKE DECISIONS IN REAL TIME

➡ FOR NAVIGATION, OBSTACLE AVOIDANCE AND CONTROL

EXAMPLES ➡ INTEL ATOM AND NVIDIA JETSON

CONTROL SYSTEM



CONTROLLERS

FUNCTIONS → TO MANAGE HARDWARE COMPONENTS IN AGVs AND AMRs

→ TO COORDINATE THE MOVEMENTS OF THE VEHICLE

→ EXECUTE TASKS, RECEIVING AND INTERPRETING SENSOR DATA

EXAMPLES → EMBEDDED CONTROLLERS AND PLCs

DATA COLLECTION

Function	Type of Sensor	Application
Safety Sensors	Safe 2D Lidar	Safe personnel detection
	Bumper	Vehicle stoppage if contact
	Encoder	Vehicle speed and steering detection
Environment Perception	2D & 3D Lidar, Ultrasonic, Camera, Radar	Avoid impacts with objects
Navigation and Localization	2D & 3D Lidar, Ultrasonic, Camera, Radar	Mapping, Localization and Navigation
	Line sensors (magentic, inductive, optic sensors)	Navigation
Load Handling	Cameras, 2D or 3D LiDAR, Ultrasonic	Pallet pocket detection
	Optical distance sensors or Wire draw encoders	Fork Height Sensors
	Photocells, ultrasonic, inductive	Ensure the right load positioning
Identification	RFID, Laser or Image based bar code scanners	Transported material identification

CONTACT SENSOR

- Contact sensors are typically known as bumpers.They stop the vehicle in case of contact with an object or a person.

- The contact force must be low enough to avoid harming someone. For this reason, the vehicle speed and inertia must be coherent with the bumper dimension.

AGV Safety Laser Scanner: Non-Contact Sensors

- AGV Safety Lasers scan the surrounding area and slow down or stop the vehicle if they detect an obstacle.
- The first field is called the “warning field.” When an obstacle is detected in this field, the AGV slows down.
- Then we have the “safety field” that stops the AGV if it detects an obstacle.

AGV Environment Perception

2D or 3D LiDAR sensors

Hokuyo UST-20LX

Sick Lidar.

- Lidar (Light Detection and Ranging) sensors are used to provide a 3D view of the environment around the AGV/AMR by using laser beams to detect the distance of objects.

ULTRASONIC SENSOR


SICK Ultrasonic Sensors


MaxBotix

Collision Avoidance

➔ Ultrasonic sensors works by using high-frequency sound waves to detect objects and obstacles in their path. These sensors emit ultrasonic waves that bounce off of nearby objects and return to the sensor.

VISION SENSOR

Intel RealSense

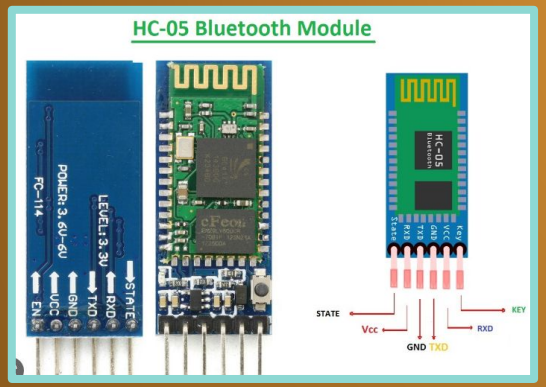
Basler vision sensors

- Vision sensors use cameras to provide visual information to the AGV/AMR about its surroundings.
- They are used for object detection, recognition, and tracking.

DATA TRANSMISSION


Ethernet Cable


Archer C1200 (WIFI)



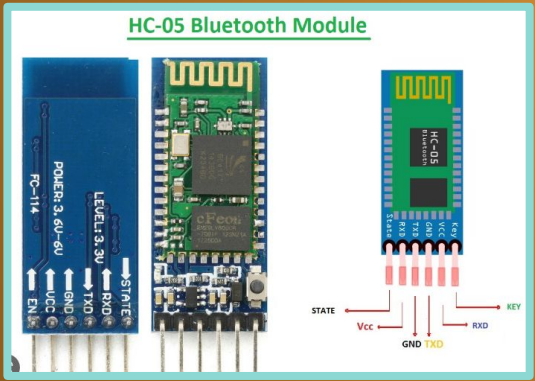

Sierra Wireless Modem

- The data transmission hardware enables the vehicles to communicate with the control system and exchange information with other devices in the environment.
- Wi-Fi: Wi-Fi is a commonly used wireless communication technology in AGVs/AMRs. It enables the vehicles to communicate with the control system and exchange data in real-time. Examples of Wi-Fi devices used in AGVs/AMRs are wireless routers and access points.
- Bluetooth: Bluetooth is another wireless communication technology used in AGVs/AMRs. It is used for short-range communication between the AGV/AMR and other devices in the environment. Examples of Bluetooth devices used in AGVs/AMRs are Bluetooth sensors and tags.

DATA TRANSMISSION


Ethernet Cable


Archer C1200 (WIFI)




Sierra Wireless Modem

- **Cellular Modems: Cellular modems are used to provide long- range communication in AGVs/AMRs. They use cellular networks to enable communication between the AGV/AMR and the control system. Examples of cellular modems used in AGVs/AMRs are Sierra Wireless modems and Digi International modems.**

- **Ethernet: Ethernet is a wired communication technology used in AGVs/AMRs. It enables the vehicles to communicate with the control system using cables. Examples of Ethernet devices used in AGVs/AMRs are Ethernet switches and routers.**

ACTUATION HARDWARE

Stepper motor bipolar 2A 84oz 48mm 4-Lead

- Actuation hardware is used in AGVs and AMRs to carry out the tasks assigned to them.
- Motors are used to provide the necessary power to move the AGV/AMR.
- They are used for propulsion, steering, and lifting.

GRIPPER

Robotiq gripper

DH- robotic gripper

- ➔ Grippers are used to grasp and manipulate objects
- ➔ They are used in material handling applications where the AGV/AMR is required to pick up and move objects.

Power Management (Batteries & Charger)

Lithium-Ion batteries

- Batteries: Batteries are used to provide power to the AGV/AMR. They are used for propulsion, steering, and powering the computing and sensing hardware. Examples of batteries used in AGVs/AMRs are Lithium-Ion batteries and Nickel-Metal Hydride batteries.

- Chargers: Chargers are used to recharge the batteries used in AGVs/AMRs. They are used to maintain the AGV/AMR's operational time and ensure the reliability.

CONCLUSION

★ In conclusion, both AGVs and AMRs are types of autonomous vehicles used in industrial and commercial settings for material handling and logistics tasks. AGVs typically follow predetermined paths and rely on external sensors to navigate, while AMRs use onboard sensors and mapping technologies to navigate and adapt to changing environments. Both types of vehicles offer benefits such as increased efficiency, reduced labor costs, and improved safety. However, the choice between AGVs and AMRs depends on the specific application and the required level of flexibility and adaptability in the operational environment.