AUTONOMOUS MOBILE ROBOT

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ROBOTIC HARDWARE SYSTEM

INTRODUCTION

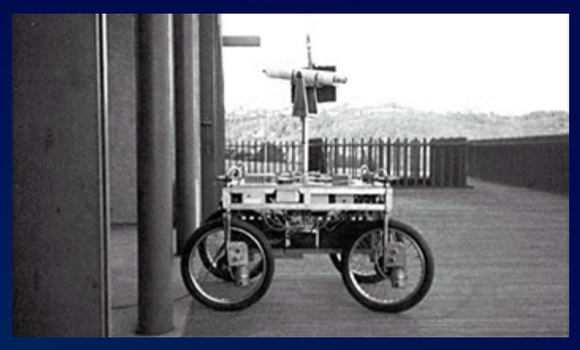
- a type of robot that is capable of navigating and operating in an environment without the need for human intervention or constant external guidance
- AMRs are designed to perform tasks or carry out specific functions autonomously, using onboard sensors, algorithms, and decision-making capabilities.

HISTORY & APPLICATIONS

1954

- UNIMATE ROBOT, DEVELOPED BY GEORGE DEVOL
- A LARGE ROBOTIC ARM THAT COULD BE PROGRAMMED TO PERFORM REPETITIVE TASKS ON AN ASSEMBLY LINE

1960

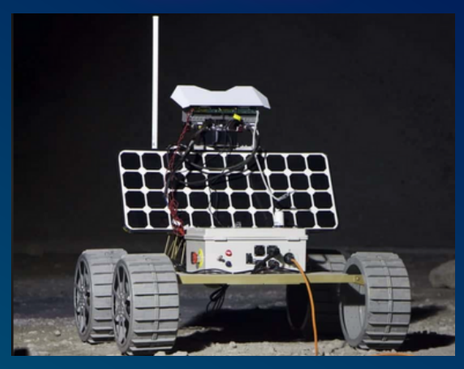


- STANDFORD CART BY STANFORD UNIVERISTY
- A SMALL MOBILE ROBOT THAT COULD NAVIGATE AROUND OBSTACLES AND FOLLOW A PRE-PROGRAMMED PATH.

1970-1980

- SHAKEY ROBOT BY STANFORD UNIVERSITY & SRI INTERNATIONAL
- CAPABLE OF REASONING ABOUT ITS ENVIRONMENT AND MAKING DECISIONS BASED ON THAT REASONING.

1990-2000



- NOMAD, DEVELOPED BY RESEARCHERS AT CARNEGIE MELLON UNIVERSITY
- EQUIPPED WITH SOPHISTICATED SENSORS THAT ALLOWED THEM TO NAVIGATE IN OUTDOOR ENVIRONMENTS AND MAP THEIR SURROUNDINGS.

MAIN COMPONENTS

ROBOT BODY DESIGN VS TASKS:

1. MATERIALS: ALUMINUM, STEEL, PLASTIC, COMPOSITE MATERIALS
2. 3D PRINTERS AND CNC MACHINES FOR PROTOTYPING AND MANUFACTURING
3. DESIGN SOFTWARE: CAD (COMPUTER-AIDED DESIGN) SOFTWARE
4. COMPLIANCE AND REGULATORY EQUIPMENT: PRESSURE SENSORS, TEMPERATURE SENSORS, CURRENT SENSORS, AND OTHER SENSORS AS REQUIRED BY RELEVANT REGULATIONS

ACTUATORS/LOCOMOTIONS:

1. MOTORS: BRUSHED DC, BRUSHLESS DC, STEPPER, SERVO, DYNAMIXEL, AC INDUCTION, HYDRAULIC, PNEUMATIC
2. BEARINGS, SLIDERS, GEARS, PULLEY SYSTEMS, SLIP RINGS, LINEAR SYSTEMS, BELTS, AND CHAINS
3. WHEELS AND TIRES: CASTERS, OMNIDIRECTIONAL WHEELS, MECANUM WHEELS, TRACKS
4. ADD-ON ACCESSORIES: MANIPULATORS, END EFFECTORS, CUSTOM TOOLS, GRIPPERS

NAVIGATION SYSTEM & CONTROLLER:

1. SENSORS: LIDAR (LIGHT DETECTION AND RANGING), CAMERAS (IR/COLOR/THERMAL), DEPTH CAMERAS, RADAR, ULTRASONIC, LASER, BUMPER SENSORS, MAGNETIC GUIDES, IMU (INERTIAL MEASUREMENT UNIT), ENCODERS
2. MICROCONTROLLERS: ARDUINO, RASPBERRY PI, BEAGLEBONE, MICRO:BIT
3. COMPUTER SYSTEMS: EDGE AI PROCESSORS (SUCH AS NVIDIA JETSON), INDUSTRIAL PCS, PC104, DAQ (DATA ACQUISITION), CONTROLLERS SPECIFICALLY DESIGNED FOR ROBOTICS (SUCH AS ROS (ROBOT OPERATING SYSTEM))
4. SOFTWARE: ROS, OPENCV (OPEN SOURCE COMPUTER VISION LIBRARY), TENSORFLOW, PYTORCH

DATA COLLECTION:

1. SENSORS: REMOTE SENSING DEVICES (SUCH AS LIDAR OR RADAR), GPS (GLOBAL POSITIONING SYSTEM), GYROSCOPES, ACCELEROMETERS, TEMPERATURE SENSORS
2. CAMERAS: RGB, THERMAL, INFRARED
3. SOFTWARE: MAPPING AND LOCALIZATION SOFTWARE (SUCH AS SLAM (SIMULTANEOUS LOCALIZATION AND MAPPING))

DATA TRANSMISSION:

1. CABLES: ETHERNET, CAN, USB, RS232/485/422, POWER CABLES
2. WIRELESS: WI-FI, BLUETOOTH, ZIGBEE, LORA (LONG RANGE), CELLULAR MODEMS (SUCH AS 4G/5G), SATELLITE MODEMS, RADIO FREQUENCY (RF) MODULES

POWER SYSTEM MANAGEMENT:

1. BATTERIES: LIPO (LITHIUM POLYMER), LIFEPO4 (LITHIUM IRON PHOSPHATE), NIMH (NICKEL METAL HYDRIDE), LEAD ACID
2. POWER MANAGEMENT SYSTEMS: VOLTAGE REGULATORS, DC-DC CONVERTERS, BATTERY MANAGEMENT SYSTEMS (BMS), POWER MONITORING SYSTEMS
3. ENERGY HARVESTING SYSTEMS: SOLAR PANELS, KINETIC ENERGY HARVESTING SYSTEMS