
MOBILE ROBOTS
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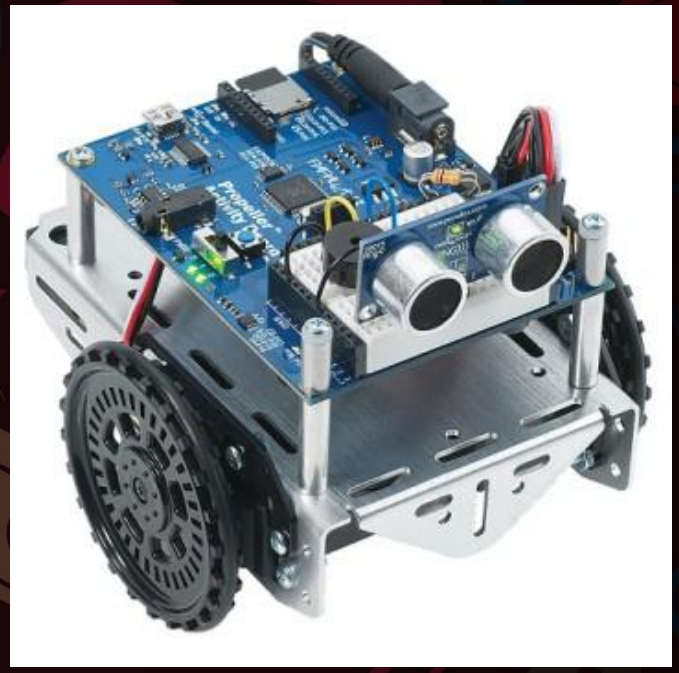
Module 6

MOBILE ROBOTS

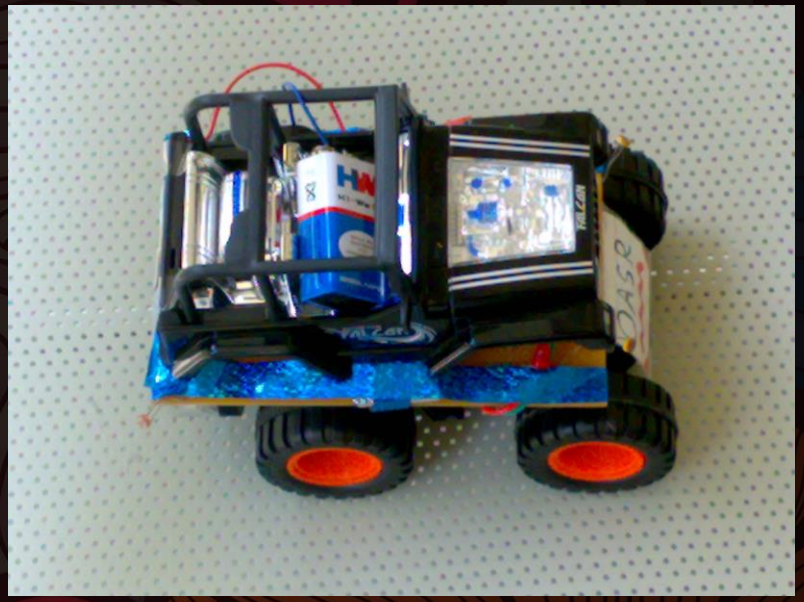
A mobile robot is a robot that is capable of locomotion. Mobile robotics is usually considered to be a subfield of robotics and information engineering.

Mobile robots have the capability to move around in their environment and are not fixed to one physical location. Mobile robots can be "autonomous" (AMR - autonomous mobile robot) which means they are capable of navigating an uncontrolled environment without the need for physical or electro-mechanical guidance devices. Alternatively, mobile robots can rely on guidance devices that allow them to travel a pre-defined navigation route in relatively controlled space (AGV - autonomous guided vehicle). By contrast, industrial robots are usually more-or-less stationary, consisting of a jointed arm (multi-linked manipulator) and gripper assembly (or end effector), attached to a fixed surface.

MOBILE ROBOTS



The components of a mobile robot are a controller, control software, sensors and actuators. The controller is generally a microprocessor, embedded microcontroller or a personal computer (PC). Mobile control software can be either assembly level language or high-level languages such as C, C++, Pascal, Fortran or special real-time software. The sensors used are dependent upon the requirements of the robot. The requirements could be dead reckoning, tactile and proximity sensing, triangulation ranging, collision avoidance, position location and other specific applications.



Classification MOBILE ROBOTS

Mobile robots may be classified by:

- The environment in which they travel:

Land or home robots are usually referred to as Unmanned Ground Vehicles (UGVs). They are most commonly wheeled or tracked, but also include legged robots with two or more legs (humanoid, or resembling animals or insects).

- Delivery & Transportation robots can move materials and supplies through a work environment
- Aerial robots are usually referred to as Unmanned Aerial Vehicles (UAVs)
- Underwater robots are usually called autonomous underwater vehicles (AUVs)
- Polar robots, designed to navigate icy, crevasse filled environments

The device they use to move, mainly:

- Legged robot : human-like legs (i.e. an android) or animal-like legs.
- Wheeled robot.
- Tracks.

Mobile robot navigation

- Manual remote or tele-op
- Guarded tele-op
- Line-following Car
- Autonomously randomized robot
- Autonomously guided robot

Manual remote or tele-op

iRobot's PackBot

A manually teleoperated robot is totally under control of a driver with a joystick or other control device. The device may be plugged directly into the robot, may be a wireless joystick, or may be an accessory to a wireless computer or other controller. A tele-op’d robot is typically used to keep the operator out of harm's way. Examples of manual remote robots include Robotics Design's ANATROLLER ARI-100 and ARI-50, Foster-Miller's Talon, iRobot's PackBot, and KumoTek's MK-705 Roosterbot.

Guarded tele-op

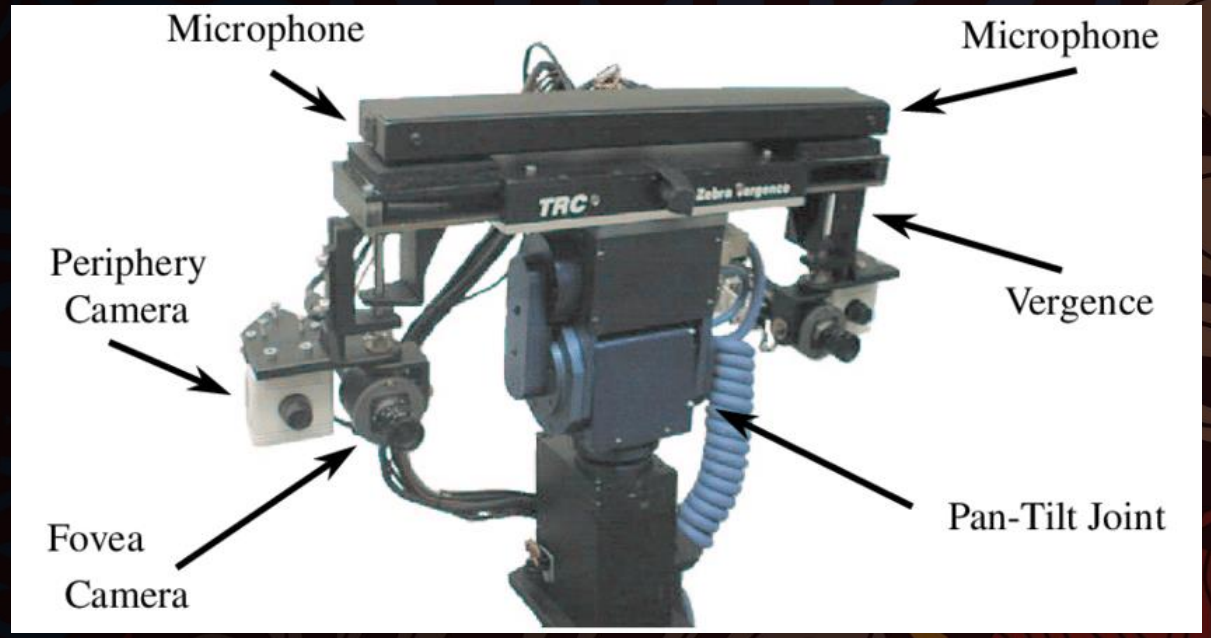
A guarded tele-op robot has the ability to sense and avoid obstacles but will otherwise navigate as driven, like a robot under manual tele-op. Few if any mobile robots offer only guarded tele-op.

Line-following Car

ROBOT MADE BY TRANSBOTICS

Some of the earliest Automated Guided Vehicles (AGVs) were line following mobile robots. They might follow a visual line painted or embedded in the floor or ceiling or an electrical wire in the floor. Most of these robots operated a simple "keep the line in the center sensor" algorithm. They could not circumnavigate obstacles; they just stopped and waited when something blocked their path. Many examples of such vehicles are still sold, by Transbotics, FMC, Egemin, HK Systems and many other companies. These types of robots are still widely popular in well known Robotic societies as a first step towards learning nooks and corners of robotics.

Autonomously randomized robot



SENSOR HEAD OF A AUTONOMOUSLY RANDAMIZED ROBOT

Autonomous robots with random motion basically bounce off walls, whether those walls are sensed.

Autonomously guided robot

Robot developers use ready-made autonomous bases and software to design robot applications quickly. Shells shaped like people or cartoon characters may cover the base to disguise it.[6] Courtesy of MobileRobots Inc

An autonomously guided robot knows at least some information about where it is and how to reach various goals and or waypoints along the way. "Localization" or knowledge of its current location, is calculated by one or more means, using sensors such motor encoders, vision, Stereopsis, lasers and global positioning systems. Positioning systems often use triangulation, relative position and/or Monte-Carlo/Markov localization to determine the location and orientation of the platform, from which it can plan a path to its next waypoint or goal. It can gather sensor readings that are time- and location-stamped. Such robots are often part of the wireless enterprise network, interfaced with other sensing and control systems in the building. For instance, the PatrolBot security robot responds to alarms, operates elevators and notifies the command center when an incident arises. Other autonomously guided robots include the SpeciMinder and the TUG delivery robots for the hospital. In 2013, autonomous robots capable of finding sunlight and water for potted plants were created by artist Elizabeth Demaray in collaboration with engineer Dr. Qingze Zou, biologist Dr. Simeon Kotchomi, and computer scientist Dr. Ahmed Elgammal

Features of a mobile robot

Each mobile robot will incorporate different features that optimize the system to meet a specific goal or perform a certain task. However, industrial mobile robot systems, perhaps the most commonly used today, possess several core features that should always be present. These features are:

- wireless communication
- integrated safety
- fleet simulation software
- fleet management software
- integration with the company's supervisory software

Uses and functions of mobile robots

The basic functions of a mobile robot include the ability to move and explore, transport payloads, or revenue producing cargo, and complete complex tasks using an onboard system, like robotic arms. While the industrial use of mobile robots is popular, especially in warehouses and distribution centers, its functions can also be applied to the medicine, surgery, personal assistance and security. Ocean and space exploration and navigation are also amongst the most common uses of mobile robots.

Mobile robots are being used to access areas, such as nuclear power plants, where factors, like high radiation, make the area too dangerous for humans to inspect and monitor themselves. However, current mobile robotics is not designing robots that can tolerate high radiation without their electronic circuitry being impacted. Attempts to invent mobile robots to deal specifically with these situations are currently being made.

Other uses of mobile robots include:

- shoreline exploration of mines;
- repairing ships;
- a robotic pack dog or exoskeleton to carry heavy loads for military troopers;
- painting and stripping machines or other structures;
- robotic arms to assist doctors in surgery;
- manufacturing automated prosthetics that imitate the body's natural functions and
- patrolling and monitoring applications, such as surveilling thermal and other environmental conditions

Safety and mobile robots

Since mobile robots, especially AMRs, are loaded with cameras and sensors, they are able to understand their environment at a higher level, thus, as mentioned before, eliminating the risk of human negligence and the accidents and other safety risks that could occur as a result of human error.

However, since the field of mobile robotics is rapidly expanding, it is necessary to create safety standards and guides specifically for mobile robots. Currently, the only relevant safety standards come from a combination of the American National Standards Institute (ANSI), the Industrial Truck Standards Development Foundation (ITSDF) and the Robotic Industries Association (RIF). The guides are the ANSI/ITSDF B56.5-2012 Safety Standard for Driverless, Automatic Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles and the ANSI/RIA R15.06-2012 Industrial Robots and Robot Systems - Safety Requirements.

Advantages and disadvantages of mobile robots

One major advantage of mobile robots is their computer vision capabilities. The complex array of sensors used by mobile robots to detect their surroundings allows them to accurately observe their environment in real time. This is valuable especially in industrial settings that are constantly changing and shifting.

The onboard intelligence system and AI used by AMRs creates another advantage. The autonomy provided by the mobile robots' ability to learn their surroundings through either an uploaded blueprint or by driving around and developing a map, enables the quick adaption to new environments and assists in the continued pursuit of industrial productivity.

Furthermore, mobile robots are flexible and quick to implement-- since they can create their own pathways and easily adapt -- possible to break up the implementation into different installations with a modular deployment system and capable of removing the potential for human error by performing easily repeatable tasks, thus improving the safety of a facility or area.