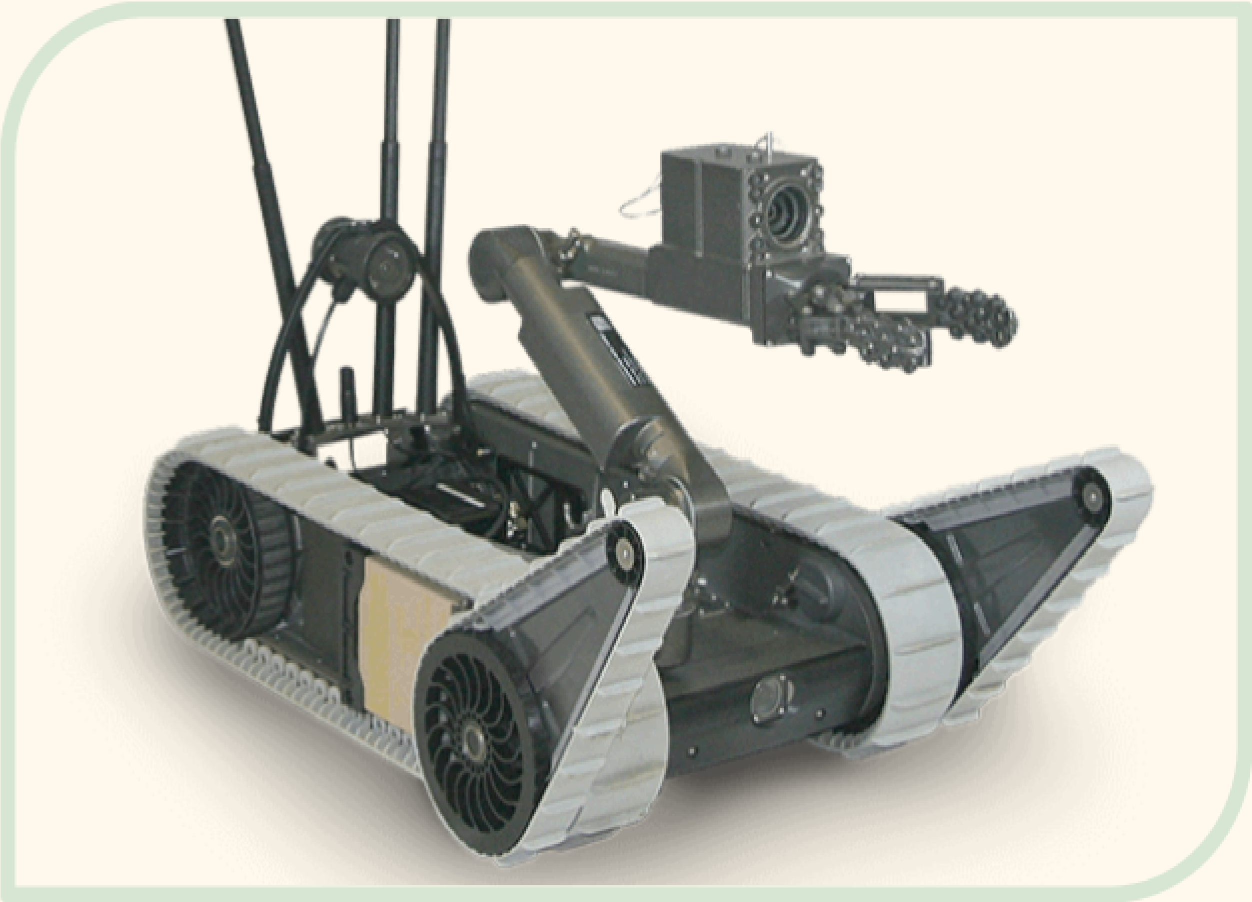
White Paper
Terrain Robot

By NewAgeRobots

INTRODUCTION

The Mobile_All Terrain Vehicle is an agile, mobile robot used for bomb disposal, search, reconnaissance, and other dangerous missions. It can easily move on rough terrain, drive through mud, and operate in all weather conditions. It is mounted with a Manipulator's arm with a lift capacity of up to 5kg. Able to climb stairs and slopes up to 45 degrees. Equipped with multiple cameras, audio capability and automatic obstacle avoidance.

Designs of terrain robots vary widely depending on their intended use. Some may have legs for traversing uneven ground, while others may have wheels or tracks with advanced suspension systems for stability and traction. Many modern terrain robots incorporate sophisticated sensing technologies like LiDAR, cameras, and GPS for navigation and obstacle avoidance. Overall, terrain robots play a crucial role in situations where human access is limited or hazardous, offering a safer and more efficient means of exploration, rescue, and operation in challenging environments.



Types of Terrain Robots

Terrain robots can be categorized based on their design, locomotion mechanisms, and intended applications. Here are several types:

Wheeled Robots:

Simple Wheeled Robots: These robots move on wheels and are suitable for flat or mildly uneven terrain.

All-Terrain Wheeled Robots: Designed with robust wheels and suspension systems to traverse rougher terrains such as rocky surfaces or uneven ground.

Tracked Robots: Tracked robots use continuous tracks similar to those found on tanks, which provide better traction and stability on rough terrain such as mud, sand, and rocky surfaces. They are often used in outdoor environments where wheeled robots might struggle.

Crawler Robots: Crawler robots move using a crawling motion, which allows them to traverse uneven surfaces, stairs, and other challenging terrain. They are commonly used in applications such as inspection, maintenance, and search and rescue.

Objectives:

Enhanced Mobility:Enable robots to navigate challenging terrains with agility, stability, and efficiency, thereby extending their operational reach and effectiveness.

Autonomy and Intelligence:Develop autonomous capabilities that allow robots to make real-time navigation decisions, adapt to unforeseen obstacles, and optimize path planning.

Sensing and Perception:Improve sensor capabilities for accurate terrain perception, including terrain classification, obstacle detection, and environmental monitoring.

Mission Effectiveness:Enable robots to fulfill their mission objectives effectively and efficiently, whether it's surveying an agricultural field, mapping a disaster site, or inspecting infrastructure.

Safety and Reliability:Prioritize the safety of both the robot and its surroundings, incorporating fail-safe mechanisms, collision avoidance systems, and robust construction.Ensure reliability and robustness in harsh operating conditions, minimizing downtime and maintenance requirements.

Cost-effectiveness:Develop cost-effective solutions that provide a favorable return on investment for end-users, balancing performance, durability, and affordability.

Human-Robot Interaction:Facilitate seamless interaction between human operators and terrain robots, providing intuitive control interfaces, effective teleoperation capabilities, and clear communication channels.

Environmental Sustainability:Promote environmentally friendly design principles, including energy efficiency, minimal environmental impact, and sustainable materials usage.

Terrain robot as bomb detector

CAD model of terrain robot

Real world terrain robot

3 DOF Arm with bomb detector.

Remote operated terrain robot with hd wireless camera feature. This robot is a tracked type robot so it easily moves uneven ground surfaces.

Next Generation Terrain Robot

4 DOF Manipulator ARM and Gripper with a 5 kg lifting capacity

Robots should be capable of running on a 45-degree slope and probably stairs.

cameras for mapping and ease the remote operation.

Why Need Terrain Robots ?

Terrain robots are essential for various reasons, spanning multiple industries and applications. Here are some key reasons why terrain robots are needed:

Exploration and Research: Terrain robots are vital for exploring remote, hazardous, or inaccessible environments where human presence is impractical or unsafe. This includes environments such as deep sea, polar regions, outer space, and disaster zones. Robots can collect data, gather samples, and conduct scientific experiments in these environments, advancing our understanding of the world around us.

Search and Rescue: In disaster scenarios such as earthquakes, floods, or collapsed buildings, terrain robots can navigate through debris, rubble, and hazardous terrain to locate and rescue survivors. Their ability to access confined spaces and operate in dangerous conditions can significantly improve the effectiveness of search and rescue operations, saving lives in critical situations.

Military and Defense: Terrain robots play a crucial role in military and defense applications, where they are used for reconnaissance, surveillance, and combat support. Unmanned ground vehicles (UGVs) can gather intelligence, detect threats, and provide logistical support in combat zones, reducing risks to human personnel and enhancing operational capabilities.

Environmental Monitoring: Terrain robots are used for environmental monitoring and conservation efforts, such as wildlife tracking, habitat assessment, and pollution detection. Robots equipped with sensors can collect data on air quality, water quality, biodiversity, and climate change indicators, helping researchers and conservationists make informed decisions and take timely action to protect ecosystems and endangered species.

Mining and Exploration: In mining and resource extraction industries, terrain robots are employed for exploration, surveying, and extraction operations in remote or hazardous environments. Robots can navigate through rough terrain, underground tunnels, or harsh climates to collect geological data, assess mineral deposits, and operate machinery in mining operations.

Construction and Infrastructure: Terrain robots are used in construction and infrastructure maintenance to perform tasks such as site surveying, inspection, and maintenance. Robots equipped with LiDAR, cameras, and other sensors can assess structural integrity, detect defects, and identify potential hazards in buildings, bridges, pipelines, and other infrastructure assets.Construction and Infrastructure

Problems & Solutions

Obstacle Navigation

Problem: Terrain robots may struggle to navigate around obstacles such as rocks, fallen trees, or debris, which can impede their progress.

Solution: Implement advanced obstacle detection and avoidance algorithms that enable the robot to detect obstacles in its path and autonomously plan alternative routes to bypass them. This may involve using sensors like LiDAR, cameras, or radar to perceive obstacles and dynamic path planning algorithms to re-route the robot in real-time.

Limited Battery Life

Problem: Terrain robots typically rely on battery power, which can limit their operational endurance, especially during extended missions or in remote locations without access to charging infrastructure.

Solution: Optimize the robot's energy consumption by using energy-efficient components, implementing power management algorithms, and reducing unnecessary power drain. Additionally, consider incorporating hybrid power systems such as solar panels or fuel cells to supplement battery power and extend operational endurance.

Limited Payload Capacity

Problem: Terrain robots may have limited payload capacity, which can restrict their ability to carry necessary equipment, sensors, or payloads for specific applications.

Solution: Optimize the robot's design for increased payload capacity by using lightweight yet durable materials, redesigning chassis or frames to support larger payloads, or integrating modular payload systems that allow for easy customization and scalability. Additionally, prioritize essential payloads and minimize unnecessary weight to maximize payload capacity.

Reference

Packbot

PackBot is a series of military robots by Endeavor Robotics (previously by iRobot), an international robotics company founded in 2016, created from iRobot, that previously produced military robots since 1990. More than 2000 were used in Iraq and Afghanistan. They were also used to aid in searching through the debris of the World Trade Center after 9/11 in 2001. Another instance of the PackBot technology being implemented was to the damaged Fukushima nuclear plant after the 2011 Tōhoku earthquake and tsunami where they were the first to assess the site.

PackBot 510 has a maximum speed of 5.8 mph or 9.3 km/h and weighs 31.6 lbs or 14.3 kg. The robot can traverse mud, rocks, stairs, and other surfaces due to its caterpillar track. The robot also has zero radius turn capability and can climb up to a 60-degree incline. The dual BB-2590/U Li-ion rechargeable batteries allow for the robot to have a run time of 4 to 8 hours. Adaptive Materials Inc. (AMI) has created a power pod battery capable of extending the life of the PackBot. The power pod weighs 6 kg(13 lbs) and allows for the extension of battery life to reach 12 hours and can maneuver in up to 3 feet of water.PackBot has more than 40 accessories which are illustrated in PackBot 510 variants. Additionally, the robot can communicate up to 1000 meters or 3281 feet and captures information through four cameras with night vision, zoom, and illumination capabilities that allow for real-time image processing.