

Robotics in Warfare, Advantages and Disadvantages, UPSC Notes

July 10, 2026 • vajiramandravi.com



In the era of modern warfare, the use of Robotics is rising rapidly. Robots can easily and safely **perform tasks** that would otherwise **endanger human lives** and they do it **faster** and more **efficiently** than with conventional methods. In military missions, robots are proving **attractive** for roles to fill the **three D's (Dull, Dirty, or Dangerous)**. For example, using robots in **mine detection** as a human. Today's robots can do the same task in about a fifth of the time and with greater **accuracy**. They provide an extended stand-off and reduce the risk of exposure.

Understanding Robotics in Battlefield

Robotics, a multidisciplinary field including **engineering** and **computer science**, revolves around the **creation, design, production, and operation of robots**. These **automated machines** are capable of performing specific tasks with minimal or no human intervention.

Features

- **Dodging Unconventional Threats:** Robotics creates **intelligent machines** that can assist humans in a variety of ways. The emergence of unconventional threats and advanced technologies necessitates a re-visit of military strategies.
- **Unmanned Systems:** In the armed forces, the term '**unmanned systems**' is commonly used to refer to these **military robots**.
- **Mobility of Robots:** Robots designed for **battlefield** applications are typically **mobile**, allowing them to navigate various terrains effectively.
 - While mobility is a key feature for battlefield robots, **static robots** find more widespread use in **industrial** and other **non-military** applications.
- **Autonomy of Robots:** This refers to the level of independence exhibited by a robot.
 - This can range from direct human control (remote operation) on one end of the spectrum to a more advanced state known as '**adaptive**' on the other.
 - A machine is considered **adaptive** when it can **learn**, enabling it to adjust, update, or modify its search parameters.
 - It can even **evolve** its methods for **gathering information**.
- **Contextual Constructs:** Robotic agents can assist soldiers in identifying dangers through contextual data - **paralinguistic, demographic, visual, and physiological variables**.
 - Robotics can be utilised in understanding acoustic variables or **paralinguistic variables** like speech intensity, pitch, etc. to recognise emotions from speech even under noisy conditions and stressful circumstances.
 - **Demographic variables** refer to characteristics like personality type, age, and gender, which can influence how soldiers interact with robots.
 - **Visual variables** refer to how robots process information from their surroundings. Providing **context** to the robot combined with the captured **image** would help it make sense of the battlefield situation.
 - Robots can monitor **physiological variables** such as soldiers' physical and emotional state.

Significance

Robotics in warfare has significance in multiple aspects:

- **Cost and Lives of Soldiers:** The robotic technology has matured to the point where affordable robots can be manufactured and employed.
- **Speed and Precision:** The AI-powered robots, equipped with contextual understanding and adaptability, offer a significant advantage with their enhanced speed, strength, and precision in warfare.
- **Efficiency:** In contrast to humans, robots do not require rest, sustenance, or recreational breaks during work and have high concentration.
 - Robots need to take breaks only for **recharging** or **refuelling**, and the repetitive nature of complex, dangerous activities does not affect their efficiency or efficacy.
 - They can be employed on the battlefield for tasks requiring incredibly **high concentration**, and difficult for humans to sustain for long periods.
- **Difficult Tasks:**

- Robotic systems can operate in environments contaminated by **biological, chemical** or **radiological weapons**, where a human would have to wear a bulky suit and protective gear.
- They can sustain extremes of operating situations, like high '**G**' turns (gravity force when you change direction and velocity due to **inertia**) that can **render aircraft pilots inoperative**. Unmanned systems can **fly faster** and turn harder.
- In **underwater operations**, small **robotic boats** can operate in the rough ocean where waves are eighteen feet high or more, and human sailors would suffer serious physical injury from all the tossing about.
- **Aggressive attacking:** Humans can only react to incoming mortar rounds by taking cover at the last second, whereas the **Counter Rocket Artillery and Mortar (CRAM)**, a robotic system **deployed in Iraq by the US**, could **detect and shoot** them down before they arrived at the target.

Concerns

- **Ethical concerns:** It raises ethical concerns as they may lack the ability to make moral judgments, potentially violating human rights and international humanitarian laws.
- **No accountability:** The lack of clear accountability for actions taken by autonomous weapons poses a significant challenge.
- **Unpredictability:** The unpredictable nature of autonomous systems poses a risk as to how they will respond in battlefield scenarios.
- **Potential arms race:** It can lead to an arms race, with nations competing to enhance their robotic capabilities.
- **Lack of empathy:** The removal of humans from decision-making eliminates the capacity for empathy and nuanced judgement.
- **Fear of unemployment:** It could lead to a reduction in the demand for human military personnel, potentially leading to job losses.

Applications of Robotics in Warfare

Robots provide diverse capabilities across a range of military operations across all domains.

- **Surveillance and Reconnaissance:** The Unmanned Aircraft Systems (UAS) provides vital **intelligence, surveillance**, and **reconnaissance** (ISR) capabilities to troops.
 - From large platforms like the **Predator** and **Global Hawk** to smaller drones like the **Raven** and **Wasp**, UAS has become essential for both tactical and strategic operations.
- **Search Operations:** Unmanned Ground Vehicles (UGVs) have proven their worth, especially in **combating improvised explosive devices (IEDs)** and explosive detection.
 - Robots like **PackBot** and **TALON** are used for tasks such as Explosive Ordnance Disposal (EOD) and reconnaissance.
 - New designs like **MARCBOT** and **MAARS** are equipped with advanced features like **weaponry** and **detection** equipment.
- **Medical Assistance and Evacuation:** Robots like **Bloodhound** and **REV** are designed to provide **medical assistance** and **evacuation** in combat situations.

- **Transportation:** The introduction of the **Multifunction Utility/Logistics and Equipment Vehicle (MULE)**, similar to a robotic pack mule.
 - It offers promising prospects for **carrying equipment and supplies** in challenging terrains.
- **Mine Clearance:** Unmanned Maritime Vehicles (UMVs) are gaining importance, particularly in **Mine Counter-Measures (MCM)** operations.
 - **Unmanned surface vehicles (USVs)** and **undersea vehicles (UUVs)** play crucial roles in **mine hunting, sweeping**, and other maritime security tasks.
 - Submarine-launched UAVs, like the **Cormorant**, extend the operational range of naval forces.
- **Training:** The futuristic utility of Robots lies in giving **combat training** and providing an interactive training solution that simulates live combat.

Global Developments in Military Robotics

Presently, the **United States** leads in military robot usage, but countries like **China, Russia, India** and others are making significant investments in research and development to close the gap.

Robot	Country	Details
PackBot	USA	- It is a series of military robots by Endeavor Robotics which were used in Iraq and Afghanistan. - Aided in searching through the debris of the World Trade Center after 9/11 in 2001. - Implemented in the damaged Fukushima nuclear plant to assess the site. - To be used in collaboration with NASA for their rovers and probes in future.
TALON	USA	- It is a remotely operated vehicle, and it is a small, tracked military robot designed for missions ranging from reconnaissance to combat. - It was used for a classified mission by US Special Forces in the war against the Taliban in Afghanistan.
Shahed-129	Iran	- It is a single-engine, medium-altitude and long-endurance unmanned combat aerial vehicle (UCAV). - It is capable of combat and reconnaissance missions and has an endurance of 24 hours; it is similar in size, shape and role to the American MQ-1 Predator.

Rex MK II	Israel	- It is a multi-mission system providing direct support to manoeuvring infantry units. - It can perform a variety of tasks: • tactical logistic support • tactical ISR • operating lethal weapons through target acquisition • evacuating wounded soldiers - The Rex includes a “follow-me” driving mode adapted for infantry forces.
THeMIS	Estonia	- It is an unmanned ground vehicle (UGV), a ground-based armed drone vehicle. - The main purpose of the THeMIS Transport is to support on-base logistics and provide last-mile resupply for fighting units on the front line.
MQ-1 Predator	USA	- It is often referred to as the Predator drone, which is a remotely piloted aircraft (RPA). - It was used primarily by the United States Air Force (USAF) and the Central Intelligence Agency (CIA).

India’s Developments in Military Robotics

India recognises the potential of robotic technology for military applications. As a result, it has been actively advancing in this field through organisations like the **Defence Research and Development Organisation (DRDO)** and other **public sector enterprises**.

- **Centre for Artificial Intelligence and Robotics (CAIR):** It was established in 1986 with a primary research focus on Artificial Intelligence (AI), Robotics, and Control systems.
- **DRDO:** The DRDO, in collaboration with Hindustan Aeronautics Limited and the Aeronautical Development Agency, has been actively involved in the development of a diverse range of Unmanned Aerial Vehicles (**UAVs**) and Unmanned Combat Aerial Vehicles (**UCAVs**).

Indian Military Robots

Robots	Features
--------	----------

Lakshya	- Lakshya is a reusable high subsonic aerial target system using a gas turbine engine and can be launched either from land or ship. - It can carry two tow targets of 1.5 km lengths each, having radar, IR or visual signature augmentation and Miss Distance Indication Scoring System. - It was inducted into the Indian Air Force (2001), Indian Navy (2001) and Indian Army (2003). - Lakshya-2 is the advanced version of Lakshya-1. It is a target for weapon systems like radar-guided and heat-seeking air-to-air missiles and surface-to-air missiles with enhanced endurance, autonomous and low-level flight capability and automated test equipment.
Daksh	- It is an electrically powered, remotely controlled robot, specialising in locating, handling, and safely neutralising hazardous objects, and can operate for 3 hours. - It has an impressive array of capabilities, including the ability to locate bombs via X-ray technology, pick them up using a gripper arm, and defuse them with a jet of water. - This remotely operated vehicle (ROV) can be controlled by fibre optic communication over a 100m distance or can be controlled by wireless communication over a 500m line of sight.
'Netra' UAV	- It stands as a testament to India's progress in this field, designed for conducting surveillance and reconnaissance operations, particularly in counter-terrorist scenarios within urban and forest environments.
Confined Space Remotely Operated Vehicle (CSROV)	- Also known as DAKSH MINI. It is a battery-operated tracked vehicle with multiple degrees of freedom manipulator arm (telescopic arm) weighing not more than 100 kg. - DAKSH MINI is capable of extracting suspected objects with a telescopic manipulator arm.
Surveillance Remotely Operated Vehicle (SROV)	- The DAKSH-SCOUT is remotely controlled from a portable Operator Console using Radio Frequency. - It has an adequate number of cameras suitably mounted on the platform for real-time viewing in front, at the rear and on either side.

Unexploded Ordnance Handling Robot (UXOR)	- It is capable of handling, diffusing and detecting Unexploded Ordnance (UXO) such as bombs and missiles up to 1000 kg remotely from a 1km line of sight. - It is based on an IC Engine, tracked Skid Steer Loader platform, with good cross-country mobility and six hours of endurance.
Robot Mules	- DRDO is exploring the use of robot mules for transporting arms and equipment in challenging terrains and high-altitude environments.
UGVs	- There is a need for Nuclear Biological and Chemical (NBC) surveillance vehicles, hence, an Unmanned Ground Vehicle (UGV) is being developed at VRDE, Ahmednagar, and is going for trial runs.

India's Security Measures against Military Robots

The following are the countermeasure developments in India:

- **Indrajaal:** Hyderabad-based Grene Robotics unveiled India's first AI-powered anti-drone system, **Indrajaal**.
 - The system provides a wide-area **Counter-Unmanned Aircraft System (C-UAS)** and is capable of protecting vital installations and entire cities from various types of drones.
 - It offers **360-degree protection** with real-time threat detection, identification, classification, tracking, and neutralisation capabilities.
 - It addresses a range of autonomous drone threats, from low radar cross-section to high-altitude long-endurance UAVs, loitering munitions, and swarm drones.
- **Comprehensive Integrated Border Management System (CIBMS):** It involves the deployment of a range of **state-of-the-art surveillance** technologies such as **thermal imagers, infrared** and **laser-based intruder alarms, aerostats** for aerial surveillance, and **unattended ground sensors**.
 - It helps in detecting intrusion bids, radars, sonar systems to **secure riverine borders**, fibre-optic sensors and a command and control system that shall receive data from all surveillance devices in real-time.
 - Implementation of
 - CIBMS projects on the **Indo-Pakistan** and **Indo-Bangladesh** border will enhance the capabilities of the Border Security Force (BSF).

Source: <https://vajiramandravi.com/upsc-exam/robotics-in-warfare/>

© Vajiram & Ravi. For personal use only.