Robotics in the Military

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ABSTRACT

Technology is transforming how humans and machines work together. Advancements in technology have reshaped the landscape of military operations, with robotics emerging as a transformative force. The integration of robotics in the military has ushered in a new era of efficiency, precision, and adaptability on and off the battlefield. The use of robots in warfare is being researched as a possible future means of fighting wars.

A military robot is an independent robot or remote-controlled mobile robot specially intended for military applications. Military robots save military lives by using these robots in applications that could be dangerous for human personnel. Some believe the future of modern warfare will be fought by automated weapons systems. This paper examines the various uses of robots in the military.

KEYWORDS: military, defense, robots, robotics, robotic soldier, warfare, war robot, types of military robots

INTRODUCTION

Robotics constitutes one of the most exciting fields of technology today. It is the discipline of designing and constructing intelligent machines, called robots. A robot is an autonomous mechanical device that is designed to sense its environment, carry out computations to make decisions, and perform actions like humans in the real world. Popular interest in robotics has increased in recent years. Robots are becoming more and more common in our society and more integrated into our lives. This is due to the fact that they are becoming smarter, smaller, cheaper, faster, more flexible, and more autonomous than ever before. Robotics technology has been implemented in a variety of fields including manufacturing, medicine, elderly care, rehabilitation, education, agriculture, home appliances, search and rescue, car industry, defense, and more.

Robotics constitutes one of the most exciting fields of technology today, presenting new applications for autonomous systems that can impact everyday life. Today, there are robots that can autonomously sense, reason, plan, act, move, communicate, and collaborate with other robots. The robotics revolution is going to change us as humans [1].

Robotics is the discipline of designing and constructing machines, called robots.

A robot is an autonomous mechanical device that is designed to sense its environment, carry out computations to make decisions, and perform actions likehumans in the real world. It is a system that contains sensors, control systems, power supplies, and software, all working together to perform a task. Robotics is a relatively young field with highly ambitious goals. It is producing a huge range of devices, from autonomous vacuum cleaners to military drones [2].

The goal of robotics is to create intelligent machines (called robots) that behave and think like humans. Robots were originally intended for use in industrial environments to replace humans in tedious and repetitive tasks. Today, robots help human beings in everyday life. They are regarded as intelligent agents that can perform actions similar to what humans can do. It is not just on the ground, military robots have

been taking to the skies—and the seas and space, too. They are being used for everything from maintaining, painting, and sanding equipment to maintaining aircraft.

WHAT ARE ROBOTS?

The word "robot" was coined by Czechriter Karel Čapek in his play in 1920. Isaac Asimov coined the term "robotics" in 1942 and came up with three rules to guide the behavior of robots and later added the zeroth law [3]:

➢ Law 0: A robot may not injure humanity or through inaction, allow humanity to come to harm.

➢ Law 1: Robots must never harm human beings,

➢ Law 2: Robots must follow instructions from humans without violating rule 1,

➢ Law3: Robots must protect themselves without violating the other rules.

Robots are becoming increasingly prevalent in almost every industry, from healthcare to manufacturing. Figure 1 indicates that robotics is one of the branches of artificial intelligence.

Although there are many types of robots designed for different environments and for different purposes/applications, they all share four basic similarities [4]:

1. All robots have some form of mechanical construction designed to achieve a particular task;

2. They have electrical components which power and control the machinery;

3. All robots must be able to sense its surroundings; a robot may have light sensors (eyes), touch and pressure sensors (hands), chemical sensors (nose), hearing and sonar sensors (ears), etc.

4. All robots contain some level of computer programming code.

Programs are the core essence of a robot since they provide intelligence. There are three different types of robotic programs: remote control, artificial intelligence, and hybrid. Some robots are programmed to faithfully carry out specific actions over and over again (repetitive actions) without variation and with a high degree of accuracy.

Robotics is an interdisciplinary field that involves the design, construction, operation, and use of robots. It is a branch of engineering and computer sciences that includes the design and use of machines that are capable of performing programmed tasks without human involvement. The field develops machines that can efficiently carry out various tasks, can automate tasks, and do various jobs that a human might not be able to do. Robots could someday be our drivers, companions, collaborators, teachers, specialists, and exploration pioneers.

MILIRARY ROBOTS

Broadly defined, military robots date back to World War II and the Cold War in the form of the German Goliath tracked mines and the Soviet tele tanks. Military interest in robotics was spotty during the Cold War, with inventors repeatedly finding that what was technically possible mattered less than what was bureaucratically feasible. In spite of some setbacks, the American military robotics community did not waver in its belief in the usefulness of its work. Over the rest of the 1990s, as sensors and computer processors improved, unmanned systems became ever more capable. With a change in military mentality, money, and use, the groundwork was finally laid for a real military robotics industry.

Many of the military robots in development today can perform highly skilled tasks with remarkable precision. The majority of them are tele-operated and not equipped with weapons; they are used for reconnaissance, surveillance, sniper detection, neutralizing explosive devices, etc. Military robots are used for detecting and disarming bombs, underwater scouting, cargo transportation, and more. The vast majority of military robots are being used behind the scenes to keep everything up and running. American soldiers have been known to name the robots that serve alongside them. These names are often in honor of human friends, family, celebrities, pets, etc.

TYPES OF MILIRARY ROBOTS

The military and defense organizations have developed different kinds of robots to drive efficiencies, protect the lives of soldiers, traverse hazardous environments, respond to emergencies, and improve mission accuracy. Examples of military robots include the following [5]:

1. *Armed Robots:* These robots are equipped with weapons to help the military eliminate threats in combat, improve their operations, and help in defense systems,

2. *Unmanned Ground Vehicles:* These robots are used for a variety of purposes, including bomb disposal, reconnaissance, communications, and patrolling in challenging terrains.

3. *Training Robots:* These military robots offer training solution that simulates live combat.

4. *GuardBot:* This spherical amphibious robot can roll on any terrain and is used for surveillance, security, and military missions.

5. *Transportation Robots:* This robotic technology can help soldiers transport different supplies like artillery, bombs, and other supplies. These are also called logistics robots.

6. *Search and Rescue Robots:* These military robots are designed to assist in search and rescue missions.

7. *Mine Clearance Robots:* These are military robots that are designed specifically to detect and clear land mines. An example of mine clearance robot is shown in Figure 2 [5].

8. *Firefighting Robots*: These military robots can assist in extinguishing fires that may occur during combat.

9. *Surveillance Robots*: These robots can assist the military to survey and spy on the enemy or potential threats.

10. *Defense Robots:* These are professional service robots that are deployed by the military in combat scenarios, protecting, and enabling soldiers in combat.

11. *Robotic Dog*: A robotic dog is a four-legged robot that moves across a sandy desert landscape. An example of a robotic dog is shown in Figure 3 [6].

12. *Robotic Mules:* Robotic mules could transform the logistical backbone of military operations, featuring all-terrain mobility to navigate through the harshest landscapes. Figure 4 shows some examples of robotic mules [7].

13. *Military Drones*: These are flying robots that are primarily used for reconnaissance and scouting, able to venture into dangerous territory and retrieve intelligence.

14. *Service Robots:* Since the military is never sure of what they are going to encounter on a mission, service robots can be sent into dangerous situations to keep soldiers at a safe distance.

15. *Submarine Robots:* These are robots that operate in the sea domain. They are also called underwater robots. An example of underwater robot is shown in Figure 5 [8].

APPLICATIONS OF MILITARY ROBOTS
Military robots are used for a variety of purposes including defense, search and rescue, surveillance, security, and transportation. Today, robots are used for a wide range of tasks, from reconnaissance to combat. The military is using robotics in the following specific ways [9]:

1. *Military Transportation:* Transporting military equipment, such as bombs and artillery supplies, carrying soldiers to and from battlefields, and recovering injured soldiers or casualties are different roles that can be performed by a military transportation robot. These robots can drive logistics efficiencies, reduce the physical burden placed on soldiers, and navigate difficult terrains

in adverse weather conditions. They are typically unmanned ground vehicle (UGV) robots that come equipped with wheels or legs.

2. *Surveillance:* Fitted with weapons, high-sensor cameras, and infrared vision, surveillance robots are critical to military operations. They enable the close monitoring of enemy territories to provide battlefield intelligence and, ultimately, tactical advantage.

These robots negate the need for human scouts, and help safeguard the lives of all soldiers on a mission. For example, Guardbot is a spherical amphibious surveillance robot that can roll on any terrain, including snow, sand, and dirt. Though originally developed for missions to Mars, the robot has applications in surveillance, security, and military missions.

3. *Search and Rescue:* Casualties often occur in war zones because it is too difficult or too risky to extract injured soldiers. These military robots provide critical support in finding missing or captured personnel. They can often go where humans cannot, whether underwater, through floods, wildfires, or over mountains. Autonomous or remote-controlled search and rescue robots can drastically reduce emergency response time, accurately pinpointing the location of human life and immediately embarking on a rescue mission. These robots are especially useful in disaster relief such as supporting local search and rescue after a tsunami, earthquake, or other natural disasters. For example, a dog-like robot called Jueying X20 is able to navigate uneven terrains. It can carry important medical equipment such as oxygen tanks, making it invaluable in a search and rescue mission.

4. *Neutralizing:* There are robots that detect and remove landmines and sea mines and sophisticated robotic arms that neutralize suspicious objects or bombs without putting a single human life at risk. These robots are typically used for route clearing, checkpoints, and vehicle inspections.

5. *Drones:* Drones are perhaps the most well-known application of robotics in the military. These flying robots are either remotely controlled or programmed to fly autonomously through software-controlled flight plans. Military drones are often the first responders in an emergency situation. With the ability to hover over an area for an extended period, they can assess hazards, gather intelligence, and pinpoint lost or wounded soldiers. For example, US Air Force has

developed the technology to equip autonomous drones with face recognition technology. These drones are intended for use by special operations forces to gather intelligence ahead of missions in foreign countries. Robot drones, mine detectors, and sensing devices are common on the battlefield but require direct control by humans. Figure 6 depicts a solder assembling a Ghost-X drone [10].

6. *Firefighting:* Fires are commonplace in combat and they remain one of the biggest threats to shipboard life, but that is something the US Navy is hoping to change. In 2015, it unveiled SAFFiR (Shipboard Autonomous Firefighting Robot), a humanoid-type robot that can navigate a ship's narrow passageways and has enough battery power for 30 minutes of firefighting. It can move through black smoke, manipulate fire-suppressing equipment, and throw propelled extinguishing agent technologies grenades. These military robots can be linked up to a fire hydrant to help investigate a fire site as well as put out fires to save victims' and firefighters' lives.

7. *Autonomous Vehicles:* Remote-controlled or autonomous vehicles are the future of military transportation robots since they can advance into a war zone, or another hazardous situation, without putting additional human lives at risk. They are designed for various military applications, from transport to search and rescue and attack. The self-driving vehicles will aid in the automation of future US Army ground vehicles, designed to navigate complex terrain and provide the army with the ability to remotely operate vehicles during high-risk missions. There have been some developments towards developing autonomous fighter jets and bombers. However, military weapons are prevented from being fully autonomous; they require human input at certain intervention points to ensure that targets are not within restricted fire areas as defined by Geneva Conventions for the laws of war.

MILITARY ROBOTS AROUND THE WORLD
The United States is far from the only country interested in robotics capabilities. Robotics is one of the hot fields of modern age in which the nations are concentrating upon for military purposes in the state of war and peace. The global military robots market size is expected to reach $32.7 billion by 2030. However, the rapid development of disaster and battlefield-ready robots has left the United Nations and human rights groups uneasy. We consider how military robots are being used in the following nations.

➢ *United States:* When it comes to military use of robots, the US leads the way despite leadership changes and funding issues, and continues to do so in ethical ways, with international support. In the United States, the Department of Defense (DoD) is the largest customer for unmanned systems technologies. The US military is investing heavily in the RQ-1 Predator, which can be armed with air-to-ground missiles and remotely operated from a command center in reconnaissance roles. A single aircraft carrier costs billions of dollars, and the United States relies heavily on its ten aircraft carrier strike groups to project power around the globe. But as military robots match more capabilities found in nature, things might change. The U.S. military is now experimenting with sentient unmanned vehicles that literally think like their human creators.

➢ *China:* China is no stranger to robots. China and its connecting regions have a basic influence to play that will help the market with fostering the locale. The overall autonomous robots market predicts the creating responsibility of associations like Alibaba, Walmart, and Amazon, which encourages a creating necessity for AGVs for dispersion focus motorization on a drawn-out scale for the smooth conduction of the market exercises. The Chinese People's Liberation Army (PLA) is in possession of the small ground robot, which can traverse complicated terrains, accurately observe battlefield situations and provide ferocious firepower. Equipped with a machine gun, and observation and detection equipment including night vision devices, the robot can replace a human soldier in dangerous reconnaissance missions.

➢ *Russia:* Russia's defense leadership, military theorists, and military practitioners are showing keen interest in robotic military applications featuring varying degrees of autonomy in performing their tasks. Moscow's military campaigns against Ukraine and in Syria have become the testbeds of such applications.

➢ *India:* Today, India is one of the developing nations in the world. The country's defense plays an important role in uplifting the nations growth and strengthening the defense system is most important to protect the country and the people. Indian military aims to add an additional feature to defense mechanism which helps to fight against terrorism and antisocial activities. Their Defence Rover is a military based application robot that can used in critical conditions such as

surgical strikes, secret sting operations, anti-violence, anti-terrorism, and during natural disasters. It is a man operated system. It is designed to combat terrorism and natural disasters. It is a highly adaptable, autonomous vehicle equipped with advanced sensors, communication systems, and specialized tools. The striking feature of this rover is that it is able to fly in air as a drone and also travel in water. The Defense Rover is shown in Figure 7 [11].

BENEFITS

Robotics for military applications is a rapidly growing and evolving field that offers many benefits and challenges for the military and society. Perhaps the main reason robots are crucial to the military mission is their ability to protect human life. Robots are cheaper to make than training and caring for living, breathing human soldiers. Since military robots are lifeless technologies, they can perform challenging and even hazardous tasks that would be otherwise risky or impossible for humans. They help reduce labor-intensive tasks and reduce the risk of threats, accidents, injury, and death for their human counterparts. Other benefits of military robots include the following [12]:

1. *Impersonalizing War:* Unmanned systems have a profound effect on the impersonalization of battle. Robots do not have emotion or an instinct of survival and will not lash out in fear. They show no anger or recklessness because they are not programmed to. As AI improves, we will see computers that can carry out orders more efficiently and reliably after they are programmed to do so, and they will not think twice about their orders. The hope that technology will reduce the violence of war is a venerable one. Some analysts believe that robot warriors can help reduce the flow of blood and perhaps make war more moral. The war weapons do not just create greater physical distance, but also a different sort of psychological distance and disconnection.

2. *Cost Reduction:* Robots can reduce the costs and risks of military operations by replacing or supplementing human personnel, equipment, and vehicles. Robots will be much less expensive than hiring soldiers. However, in order to deploy autonomous killers, we must weigh the costs and benefits over many issues. Since the cost of human life is the largest cost any technology can accrue, replacing humans with robots is reasonable and ethical.

3. *Reducing Mistake:* Many wartime atrocities are not the result of deliberate policy or fits of anger; they are just human mistakes. Unmanned systems

seem to offer several ways of reducing the mistakes and unintended costs of war. Their precision superior to what humans could marshal on their own can lessen the number of mistakes made. It is easy to see how collateral damage can be greatly reduced by robotic precision.

4. *Reduction of Risk*: One of the primary benefits of deploying robotics in military operations is the ability to reduce risks for human soldiers. The removal of risk allows decisions to be made in a more deliberate manner than normally possible. Soldiers describe how one of the toughest aspects of fighting in cities is how you have to burst into a building and, in a matter of milliseconds, who is an enemy and who is a civilian and shoot the ones that are a threat before they shoot you. A robot can only shoot at someone who shoots first, without endangering a soldier's life. Some feel that unmanned systems can remove the anger and emotion from the humans behind them. Figure 8 illustrates how robots can save wounded soldiers from the battlefield [13].

5. *Human in the Loop*: While military robots are useful for many applications, every implementation of military robots includes a human being (usually several). Robots can do a lot of different things, but humans are needed at every step, from building to maintaining to programming to overseeing. Even more worrisome, the concept of keeping human beings in the loop is already being eroded by policymakers and by the technology itself.

6. *Robotic Jobs*: Where there are robots, there are robotics jobs, and military robotics programs are no exception. When we talk about robotics jobs, we are usually speaking about robotics in the manufacturing industry. The military needs robotics workers just as much as the manufacturing industry, because they use robotics to maximize their effectiveness. Robots are primarily protecting people and improving the safety of personnel.

7. *Increased Trust:* The military is building trust through rigorous validation and verification of their autonomous capabilities to mitigate direct threats to the warfighter – ultimately, increasing mission readiness.

8. *Maximized Performance:* The deployment of autonomous systems help to maximize the operational effectiveness of a mission while ensuring the safety of the human-in-the-loop across air, land, sea, and space.

9. *Enhanced Precision:* Robotics in the military significantly enhance precision in various tasks,

from reconnaissance to targeted strikes. Unmanned systems can be equipped with advanced sensors and targeting technologies, allowing for surgical precision in operations while minimizing collateral damage. This precision contributes to the overall reduction of civilian casualties and infrastructure damage.

10. *24/7 Surveillance and Monitoring:* Unmanned systems, including drones and surveillance robots, provide continuous monitoring capabilities. This 24/7 surveillance enhances situational awareness, allowing military forces to respond quickly to emerging threats.

11. *Logistical Efficiency*: Autonomous ground vehicles and drones can be employed for logistical tasks, including supply transport and resupply operations. This not only increases the efficiency of logistical processes but also reduces the burden on human personnel, freeing them up for more strategic and specialized tasks.

12. *Flexibility:* Robots can improve the efficiency and effectiveness of military operations by increasing speed, accuracy, endurance, and flexibility. Robotics in the military offer a high degree of adaptability and flexibility. Unmanned systems can be rapidly deployed and reconfigured for various missions, allowing military forces to respond dynamically to changing circumstances.

13. *Cost-effectiveness:* The Department of Defense (DOD) spends millions of dollars on training soldiers to wage war. Training one soldier costs between $50,000 to $100,000, with an annual cost of at least $100,000 to maintain the soldier's health, training, and other benefits like salary and housing. In contrast, robots require about the same initial cost but much less in maintenance and storage. Using robots in the U.S. Army would reduce the cost of recruiting, both from the monetary and behavioral health impacts.

CHALLENGES

There are many challenges ahead to integrate robots and soldiers on the battlefield. The robotics industry is constantly changing and evolving. Humans do not know what the ultimate technological performance limit for autonomous robotics is. Robots can create technical and operational difficulties for the military, such as the reliability and security of the systems, the interoperability and integration with other systems, and the training and maintenance of the operators. Beyond technical challenges, the Army must convince Congress to alter the procurement process so the service can acquire or adapt capabilities within broader funding lines. Other challenges facing military robots include the following:

1. *Ethics*: Robotics for military applications is a rapidly growing and evolving field that offers many benefits and challenges for the military and society. The use of robots in warfare raises ethical and moral questions. In the heat of battle, fear, anger, and vengefulness can cause even the most trained soldiers to commit war crimes that violate ethical standards laid down by Geneva and other international conventions. As military robots gain more and more autonomy, the ethical questions involved will become even more complex. Autonomous machines are created not to be "truly 'ethical' robots", yet ones that comply with the laws of war (LOW) and rules of engagement (ROE). This is the main reason military lawyers are so concerned about robots being armed and autonomous. Using robots will reduce the risks so much that future wars will increase. Robots themselves have the inability to differentiate between combatants and noncombatants, which means there is a potential for higher civilian casualties.

2. *Decision Making:* A main concern is the decision-making aspect of robotic warfare. Should robots be able to make autonomous decisions about killing human beings? Or should humans continue to make the final decisions? Lawmakers, government officials, and society must decide how robots are employed in the Army. Military robots perform worse when humans would not stop interrupting them.

3. *Responsibility:* There is a possibility that machines may one day reach a point where they make more ethical decisions on the battlefield .Who is responsible when autonomous robots make mistakes? If their mistakes lead to fatalities, how do you hold robots accountable? Depending on policies, rule of law, and rules of engagement, it may be difficult to hold anyone accountable, especially if robots make independent decisions.

   The human creators and operators of autonomous robots must be held accountable for the machines' actions. They should exercise appropriate levels of judgment and remain responsible for the development, deployment, use, and outcomes of military systems.

4. *Security:* Concerns have been expressed on the security of autonomous systems compared to the remotely piloted systems currently in use. It is only a matter of time until we hand weapons over autonomous system that can outperform soldiers. The more the system is autonomous, the more it has the capacity to make choices other than those predicted or encouraged by its programmers. The

intention of engineers in designing is that robots will make less mistakes than humans do in the battlefield. Robots need to be programmed with rules about when acceptable to fire on a tank and must learn how to perform complicated, emotionally fraught tasks, such as distinguishing civilians. Lately, robots have been outfitted with teleoperated weaponry, keeping them from killing individuals all alone.

5. *Fear:* Fear of the unknown and the humane side of war driven because the possibility of reducing risk to human troops may escalate new conflicts. What if a robot army becomes a weapon of mass destruction? The fear that hackers could take control of robots and AI, leading to mass death and destruction, is among the reasons lawmakers and government officials oppose such technology.

CONCLUSION

Military robots are still in their early days. Today's modern military forces are using different kinds of robots for different applications ranging from mine detection, surveillance, logistics and rescue operations. Modern armed conflict can be fundamentally changed in the age of computers and networks. They can and will play a major role in the future of warfare; it is just a matter of when. The decision to use robots requires significant research, planning, and deliberate execution. The Pentagon has also started work on a number of unmanned systems for potential use in space, although most are still only on the drawing boards.

The use of robots in the military is only going to increase in the coming years. Robots are the future of the military. Robotics is the key to the future combat systems. For those looking to have a successful career in robotics, the military is a great option. They provide the training and on-the-job experience necessary to work with robots.

For more information about robotics in the military, one should consult the books in [14-17] and the following related journals devoted to robotics:
- Robotica
- Robotics
- Robitics and Autonomous
- *Robotics and Computer-Integrated Manufacturing,*
- *Advanced Robotics*
- *Autonomous Robots*
- *Journal of Robotics*
- *Journal of Robotic Systems*
- *Journal of Robotic Surgery*
- *Journal of Robotics and Mechatronics*
- *Journal of Intelligent & Robotic Systems*
- *Journal of Mechanisms and Robotics-Transactions of the ASME*
- *Journal of Automation, Mobile Robotics and Intelligent Systems*
- *Journal of Future Robot Life*
- *IEEE Robotics and Automation Letters*
- *IEEE Transactions on Robotics*
- *International Journal of Medical Robotics and Computer Assisted Surgery*
- *International Journal of Robotics Research*
- *International Journal of Social Robotics*
- *International Journal of Humanoid Robotics*
- *International Journal of Advanced Robotic Systems*
- *Science Robotics*
- *Soft Robotics*
- *Military Review*
- *Journal of Military Learning*
- *NCO Journal*

REFERENCES

[1] S. Brezgov, "Robots in education: Is the educational revolution just around the corner?" January 2020, https://scholarlyoa.com/robots-in-education-is-the-educational-revolution-just-around-the-corner/

[2] M. N. O. Sadiku, U. C. Chukwu. A. Ajayi-Majebi, and S. M. Musa, "A primer on robotics," *International Journal of Trend in Scientific Research and Development,* vol. 6, no. 7, November-December 2022, pp. 614-621.

[3] "Human–robot interaction," *Wikipedia,* the free encyclopedia https://en.wikipedia.org/wiki/Human–robot_interaction

[4] "Robotics," *Wikipedia*, the free encyclopedia https://en.wikipedia.org/wiki/Robotics

[5] "7 Types of robots used in the military," January 2023, https://www.adsinc.com/news/7-types-of-robots-used-in-the-military

[6] J. Detsch, "America's next soldiers will be machines," April 2024, https://foreignpolicy.com/2024/04/06/us-army-military-robots-soldiers-technology-testing-war/

[7] "The future of warfare: Robotic mules in military science fiction," https://milsf.com/the-future-of-warfare-robotic-mules-in-military-science-fiction/

[8] E. Ackerman and E. Guizzo, "How Stanford built a humanoid submarine robot to explore a 17th-century shipwreck," December 2016, https://spectrum.ieee.org/stanford-humanoid-submarine-robot

[9] L. Ross, "6 Ways the military is using robotics," March 2023, https://www.thomasnet.com/insights/6-ways-the-military-is-using-robotics/

[10] J. Judson, "The robots are coming: US Army experiments with human-machine warfare," March 2024, https://www.defensenews.com/unmanned/2024/03/25/the-robots-are-coming-us-army-experiments-with-human-machine-warfare/

[11] "Defence Rover to fight against terrorism and natural disasters," December 2021, https://www.electronicwings.com/users/ChiranjeeviGowda/projects/1672/defence-rover-to-fight-against-terrorism-and-natural-disasters

[12] "Revolutionizing defense: The role of robotics in military operations," February 2024, https://www.nextechsol.com/revolutionizing-defense-the-role-of-robotics-in-military-operations

[13] "The future is here: How the military uses robots," October 2019, https://community.robotshop.com/blog/show/the-future-is-here-how-the-military-uses-robots

[14] M. N. O. Sadiku, *Robotics and Its Applications*. Moldova, Europe: Lambert Academic Publishing, 2023.

[15] T. Cooke, *A Timeline of Military Robots and Drones*. Capstone, 2017.

[16] E. Noll, *Military Robots*. Bellwether Media, Incorporated, 2017.
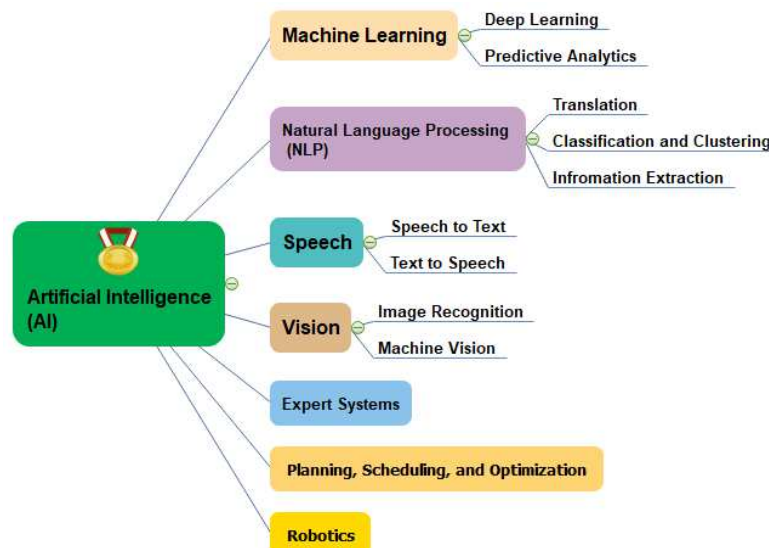
[17] S. Price, *Amazing Military Robots*. Capstone, 2013.

Figure 1 Robotics is one of the branches of artificial intelligence.

Figure 2 A mine clearance robot [5].

Figure 3 A robotic dog [6].

Figure 4 Examples of robotic mules [7].

Figure 5 Underwater or submarine robot [8].

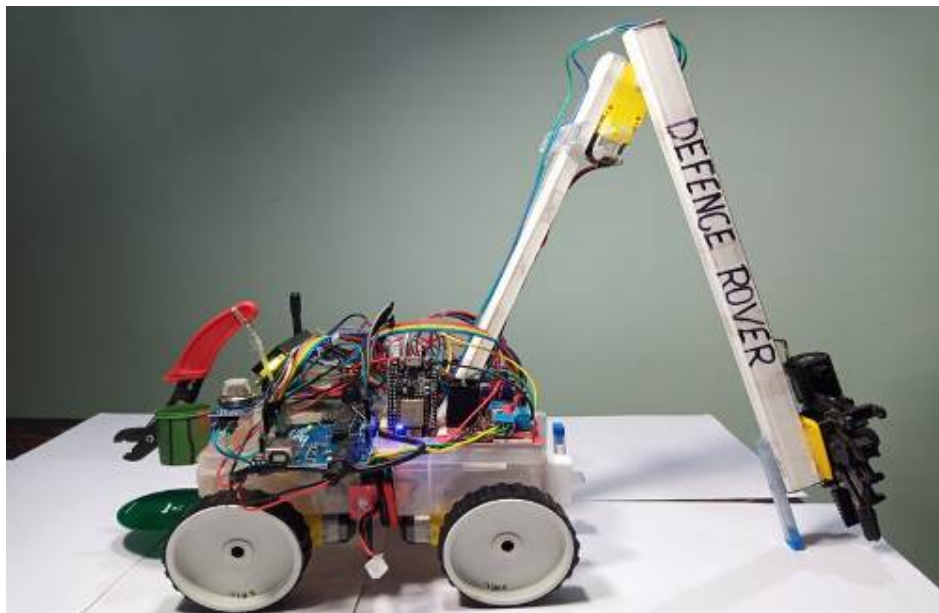**Figure 6 A solder assembling a drone [10].**

Figure 7 Indian Defense Rover [11].

Figure 8Robots can save wounded soldiers from the battlefield [12].