

Glance on Military Robot

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Abstract: *The way humans and machines collaborate is changing due to technology. The terrain of military operations has changed as a result of technological advancements, with robotics emerging as a disruptive force. A new era of effectiveness, accuracy, and flexibility both on and off the battlefield has been brought about by the military's adoption of robotics. Research is being done on the potential future of using robots to fight wars. An autonomous or remote-controlled mobile robot designed specifically for military use is called a military robot. By employing military robots in tasks that could endanger human personnel, these machines save military lives. Some people think automated weaponry will be used in modern warfare in the future. A review of earlier research on military robots is presented in this paper.*

Key Words: *Military robot, robot types, applications*

1. INTRODUCTION

In order to safeguard their boundaries and interests, societies have consistently developed technologies throughout history. One of the most important technological developments in the twenty-first century defense strategy is military robotics.

Due to their deterrent effect, these autonomous and semi-autonomous systems are changing military capabilities, possibly changing the character of conflict itself, and in certain situations, promoting strategic stability.

A wide range of unmanned systems intended to carry out tasks that were previously completed by human personnel are referred to as military robots. These include maritime systems, fixed defensive installations, ground vehicles, and aerial drones.

They can operate remotely under human supervision, semi-autonomously under human supervision, or, in certain situations, completely autonomously within carefully regulated parameters.

Unlike industrial or medical robots which are dedicated to care or productivity, military robots are designed primarily for perimeter security, logistical support, explosive ordnance disposal, reconnaissance, and occasionally offensive or defensive operations - all with primary goal of lowering/ reducing military risk.

A wide variety of unmanned systems are referred to as military robots, and they are made to carry out tasks that were previously completed by human personnel.

These include fixed defensive installations, maritime systems, and aerial drones and ground vehicles.

In certain situations, they can operate completely autonomously within very specific parameters, operate semi-autonomously under human supervision, or be controlled remotely by human controllers.

With the primary goal of lowering risk to military personnel, military robots are primarily built for perimeter security, logistics support, explosive ordnance disposal, reconnaissance, and occasionally offensive or defensive operations, in contrast to industrial or medical robots that are centered on productivity or care.

2. TYPES OF MILITARY ROBOT

2.1 UAVs

Unmanned aerial vehicles (UAVs) are capable of long-distance autonomous flight without the need for crew or passengers. UAVs were first used by the United States and Great Britain during World War I, and by the end of World War II, a number of unmanned devices were in use. The Vietnam War was the first time UAVs were used for reconnaissance. In addition to collecting intelligence, drones can launch missiles, perform mapping tasks, and act as decoys in combat.

2.2 UGVs

Similar to UAVs, uncrewed ground vehicles are made to protect military personnel while they carry out risky tasks on land.

These robots are capable of handling hazardous materials, evaluating threats, disposing of explosive devices, and conducting reconnaissance operations.

2.3 UUVs and USVs

Along with other unmanned systems, Unmanned Underwater and Surface Vehicles (UUVs and USVs) keep people from performing hazardous underwater tasks like anti-submarine warfare and mine detection.

This covers surveying, mapping, shadowing, tracking, and interception of both domestic and foreign waters. Situational awareness at sea can be provided by these systems. UUVs and USVs can be employed as maritime swarming tools in addition to collecting data, identifying other naval vessels and obstructions, and reducing exposure. Fig. 1 depicts shows each type of military robot.

3. ROBOTICS IN DEFENSE APPLICATIONS

Robotics has emerged as a game-changing tool for defense applications, improving accuracy and precision, reducing the risk to soldiers, and being employed in supply delivery, logistics, and surveillance.

Furthermore, military teams now depend heavily on robots to find missing or captured personnel during search and rescue operations. Robotic exoskeletons, underwater naval robots, ground-based robots, and unmanned aerial vehicles (UAVs) are among the different kinds of robots.

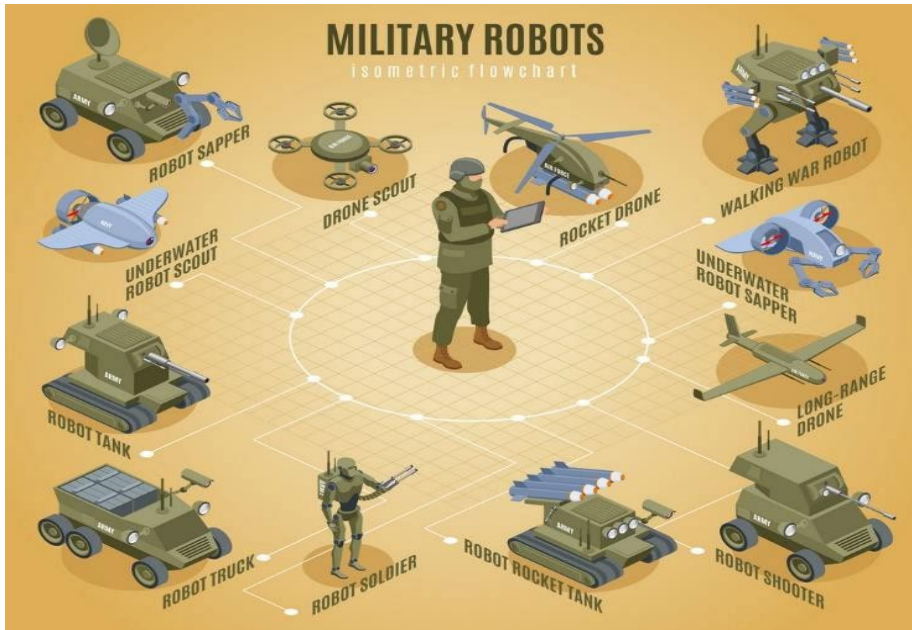


Fig. 1 - Types of military robot

4. PREVIOUS WORKS

The article in [1] discusses the various robotic technologies that are employed by the Army, Navy, and Air Forces. In addition to the robots being studied in labs for potential use in future military operations, some of the robots discussed are also being used in the wars in Afghanistan and Iraq. These robots are being studied in both autonomous and collaborative settings. We concentrate on how robots are used in both peacetime and conflict, as well as how they affect society.

An Android phone application can be used to control a robot that was designed by the authors in [2]. Via a Bluetooth interface with the controller, it transmits control commands. The Bluetooth module can be interfaced with the controller via the UART protocol. The robot can be made to move in accordance with commands sent by an Android device.

The suggested system in [3] is made up of a single unit that will provide live video feedback and monitor the surroundings in a variety of dangerous situations. An overview of robotic construction is provided by the fundamentals of robotics, such as sensors and actuators. Additionally, the suggested system can record videos in real time, which is helpful for monitoring a particular individual or location.

A Raspberry Pi3 processor is used to control the robot. For military uses like monitoring a targeted area, this robot is more comfortable. In hostile territory or during hostage situations, it will offer a tactical edge.

It has the ability to monitor a region and walk on any surface. High-quality video transmission helps to increase the effectiveness of surveillance.

The suggested system improves video quality. These will be crucial in applications such as military and civil robots.

A tank-based military robot prototype with object detection, tracking, and Android control is proposed by the authors in [4] to simulate shooting an enemy target. The authors suggest an

algorithm that uses an HC-05 Bluetooth module to control the robot. The experimental results were presented along with an explanation of the methods.

The paper in [5] examines the evolution of methods from the past to the present that make up a significant process in robot motion planning and control. In addition to emphasizing the value of integrating robotics, communications, and information analysis in the field of land mine discovery, we concentrate on real-time human detection and tracking in chaotic and dynamic environments.

In a military setting, army robots can save lives, lower costs, and are currently available in self-sufficient automotons such as drones, weapons, and unmanned aerial vehicles. The primary goal is to design and build a working prototype of an easy-to-use computerized robot that can identify covered mines and allow the user to operate it from a distance to avoid human interference. Autonomous drones, weapons, and unmanned aerial vehicles appear to be the first examples of armed forced robots, and transport logistics vehicles are following closely behind. However, the new era of robots is even more intimately related.

The design and construction of a semi-autonomous, unmanned robotic system for use in a variety of military and rescue missions is the main topic of the paper in [6]. The MSRR, Military Support and Rescue Robot, can effectively perform hazardous tasks like bomb disposal, enemy territory surveillance, search and rescue, and more. This lowers the possibility of both soldiers and civilians dying.

The soldiers can better prepare for their missions by using the wireless camera's live feed and data analysis of the area under surveillance's environmental composition from multiple sensors. The aforementioned tasks can be accomplished with the help of Arduino and Zigbee technology. The Arduino Mega, which is connected to the Zigbee, is connected to the various sensors and the robotic arm. Zigbee technology is used for both data transmission and reception. By addressing the shortcomings of the current models, this prototype design improves military operations support.

An ESP32-CAM module and a few electronic sensors are used by the authors to create a clever military robot in [7]. It appears that the ESP32-CAM lacks the power to manage some demanding real-time computer vision workloads, despite being a low power and low latency video streaming module with GPIOs and a serial connection.

The identification of intruders was implemented by the authors in [8] by taking a picture, processing it in MATLAB, and then using machine learning techniques to determine whether the person is authorized or not.

The robot then sends a laser at the adversary. The entire database is kept on the cloud. The enemy is accurately and efficiently eliminated by the regression algorithm. The results of the experiment are explained and simulated.

According to [9], the Real-time Remote User Controlled Military Robot system is an effort to reduce the number of people killed in combat zones and to access areas where human presence may be hazardous.

The system is based on the Raspberry Pi and has several features. In the war zone and close to the borders, Raspberry Pi cameras are used for surveillance. The control room uses Bluetooth technology to remotely monitor the surveillance. It will be controlled by the master in the remote via a web application.

Ultrasonic sensors are crucial to obstacle avoidance because they can determine the direction and distance of obstacles from the car.

The control room will be notified when face recognition algorithms identify the person in front of them. The enemy is shot by a laser turret. The main features are obstacle avoidance, laser turret, and surveillance.

A growing number of people want to use military robots to assist soldiers in carrying out risky tasks in today's politically unstable world [10]. Bomb disposal, hostile territory observation, and search and rescue missions are among the dangerous tasks that the Military Rescue Robot is well-suited to carry out.

As robots and the systems that support them become more technologically sophisticated, reliable, and small, the military and law enforcement are using them in a growing amount. Mobile robots are increasingly being used by the military for duties like patrolling and bomb defusing. Numerous apps that are accessible online utilize the Bluetooth, Wi-Fi, and ZigBee features that are already included in these smartphones to enable the remote control of other devices. The camera module's livestream and the data analysis of the area's environmental composition from multiple sensors (both Zi and Arduino) could aid the military in getting ready for missions.

A list of common US military robots and their development status is provided in [11], along with an analysis of the fundamental circumstances and development process of military robots and a proposal for their future.

Although there is currently little use of robotics technology in military combat, as science and technology advance, robots will become indispensable and play a big part in battlefields of the future.

The suggested algorithm in [12] is especially made to lessen the cyber vulnerability of the Robot Operating System (ROS), a popular middleware platform that is utilized extensively in both the military and civilian sectors.

We perform penetration testing (real-time man-in-the-middle cyberattacks) on the GVR-BOT ground vehicle, a military ground robot replica created by the US Army Combat Capabilities Development Command (CCDC), Ground Vehicle Systems Center, to show the effectiveness of the suggested algorithm.

Additionally, the cyberattacks take advantage of the Robot Operating System's vulnerability on its onboard computer. The authors gather experimental data and train our CNN under two distinct operating conditions: malicious and legitimate. We transform the network traffic data into RGB or grayscale images after normalizing it. To effectively feed the network traffic data to our CNN system, we present two distinct windowing technique types: independent and overlapping sliding epochs.

Our study demonstrates the effectiveness of the suggested algorithm since our suggested cyber intrusion detection system can achieve minimal detection times, a comparatively low false-positive rate of ≤ 2 percent, and reasonably high accuracies ≥ 99 percent. Furthermore, we compare and illustrate the relative advantages of our suggested algorithm in relation to the effectiveness of a few well-known methods, specifically the Support Vector Machine (SVM) and "bag-of-features" (BoFs) algorithms.

To improve land mine and explosive detection in military operations, a robotic surveillance system that combines metal detection and gas sensing technologies was developed in [13].

Using features like a gas sensor to detect explosive vapors and a taser, and a high-sensitivity metal detector to locate buried metallic components, the mobile robotic platform can navigate and map terrain on its own. By drastically increasing accuracy and lowering false positives, this detection method protects staff members.

Analyzing and making decisions quickly is made possible by sending data in real time to a distant command center. The system's effectiveness under a variety of conditions is confirmed by extensive field testing, underscoring its potential for both military and humanitarian demining applications. By fusing these technologies, the system provides a

reliable and effective way to detect land mines, improving operational safety and effectiveness in military surveillance and demining operations.

A paper in [14] describes the creation of a sophisticated camouflage robot that can dynamically change its color to blend in with its environment. By combining machine learning, computer vision, and sensor fusion, the suggested system achieves camouflaging by allowing the robot's RGB LED panels to change color in response to its environment. A real-time video feed of the surroundings is captured by the robot's video camera system.

Following video capture, a trained machine learning model processes the footage by examining the surrounding color distribution. In order to precisely identify the colors in its immediate environment, the robot simultaneously makes use of RGB color sensors. The predominant color surrounding the robot is determined by integrating the data from the camera and sensors.

By feeding the combined data into a machine learning model, the hybrid camouflaging technique determines the color of maximum distribution. The robot then turns on its RGB panels, changing their hue to match the environment's recognized dominant color, making it harder to find. By using this technique, the robot can reduce its visual impact and effectively camouflage itself. This task is accomplished through the use of KNN and sensor fusion techniques.

5. CONCLUSIONS

The development of military robots is still in its infancy. Robots of various types are employed by today's military forces for a variety of tasks, including logistics, mine detection, surveillance, and rescue missions. The era of computers and networks has the potential to drastically alter contemporary armed conflict. It is only a question of when they will and can have a significant impact on warfare in the future. The choice to employ robots necessitates careful consideration, preparation, and implementation. Additionally, the Pentagon has begun developing several unmanned systems for possible space use, though the majority are still only conceptual in nature. This paper provides a brief overview of earlier military robot research.

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