

## A Study on Intelligent Combat Robot Systems for Future Warfare

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### **Abstract**

*This study focuses on the development of intelligent combat robot systems for future warfare. The research is structured as follows: First, the introduction presents the rationale for researching intelligent combat robots and their potential to become game changers in future warfare. Second, in the context of the intelligent robot paradigm, this study proposes the need for military organizations to innovate their combat concepts and weapon systems through the effective utilization of Artificial Intelligence, Cognitive, Biometric, and Mechanical technologies. This forms the theoretical background of the study. Third, the analysis of intelligent robot systems considers five examples: humanoid robots, jumping robots, wheeled and quadrupedal pack robots, and tank robots. Finally, the discussion and conclusion propose that intelligent combat robots should be selected as game changers in military organizations for future warfare, and suggest further research in this area.*

**Keywords:** Future, Intelligence, Combat, Warfare, Combat Robot, System

### **1. INTRODUCTION**

Intelligent robots combined with artificial intelligence are completely changing the nature of future warfare. These robots are widely used in various fields such as industry, medicine, agriculture, and defense, replacing many human jobs. In addition, future defense is focused on developing intelligent combat robots that can replace human combatants or collaborate with them as game changers in combat. These intelligent combat robots can be divided into humanoid robots that resemble humans, bio-mimetic robots that mimic the form and movement of animals, and swarm drones that operate in clusters. Ultimately, this study aims to design the concept of operating combat robots in future battlefields and actively utilize intelligent combat robots as game changers in future warfare.

### **2. INTELLIGENT ROBOT PARADIGM**

To leap into a highly connected and highly intelligent army based on advanced platforms and dominate the battlefield, there is a need for innovation in military organizations to create new combat concepts and weapon systems that can utilize the AICBM, a representative technology of the Fourth Industrial Revolution, for military purposes. Currently, we are living in the era of digital transformation, and we are moving from an age

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of mechanization to an age of informatization and intelligence with the development of science and technology. Furthermore, we are living in an age where technology is mixed in high and low environments where analog and digital coexist.

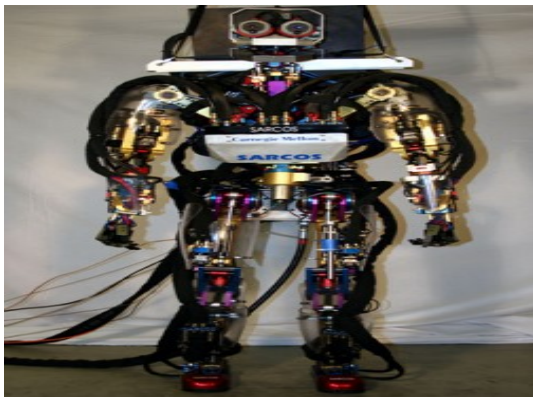
As we enter an era of intelligence based on artificial intelligence, we must prepare for future wars by utilizing new waves such as AICBM, technology that combines reality and virtuality, and other Fourth Industrial Revolution technologies for military purposes.

This robot technology is being developed competitively by countries as a technology of the Fourth Industrial Revolution, and in particular, the US DARPA is pursuing the development of various robots, including humanoid robots, and also conducting a challenge-based program for core technology of miniature robots.

### 3. ANALYSIS OF INTELLIGENCE ROBOT SYSTEM

#### 3.1 Humanoid Robots

A humanoid robot refers to a form that resembles that of a human and was first coined in 1867. When abbreviated to three letters, it means "human form" and is commonly used to refer to robots or living beings in human form [1]. Originally, anything that resembled a human, whether it was an animal or an alien, was called a humanoid, but since aliens have not been found and there are few animals that resemble humans, nowadays when we refer to a humanoid, it usually means an humanoid robot [1]. From this perspective, we can consider building multiple control strategies for the walking control of humanoid robots [2].



Source : Jung-Yup Kim(2012).

**Figure 1. SARCOS hydraulic humanoid robot**

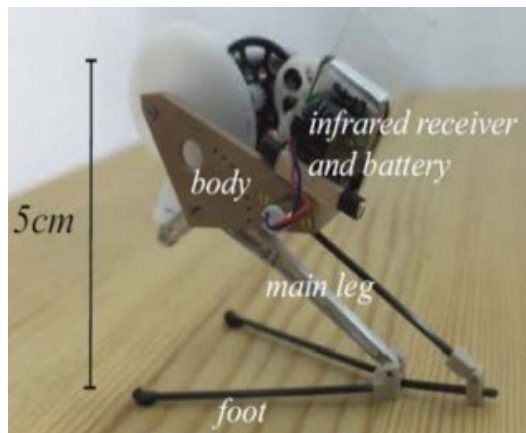


Source : KAIST(2020).

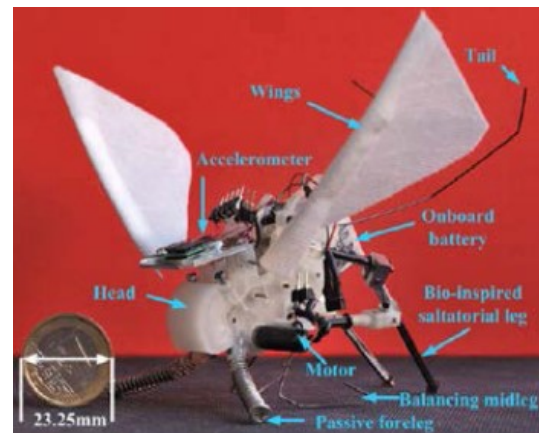
**Figure 2. Humanoid robot ubo 2**

#### 3.2 Jumping Robots

Many insects quickly jump to escape danger or to overcome high obstacles. To defy gravity and elevate their bodies to a high position, they require a significant amount of energy. However, the muscles of insects have limits to the amount of energy they can release instantly. As a result, insects do not use their muscles directly to jump. Instead, they store energy in a structure with elasticity using their muscles and then release the stored energy instantaneously to jump. This mechanism includes the escapement cam, some toothless gears, and the unidirectional bearing. Various jumping robots have been developed based on this mechanism.



Source : Sang-Min Baek, et al(2018).



Source : Sang-Min Baek, et al(2018).

**Figure 3. Jumping robot(a)****Figure 4. Jumping robot(b)**

### 3.3 Wheeled dog-horse Robot

Military combat vehicles must drive through rough terrain with many obstacles in a battlefield scenario, and in such environments, the heavy weight of the vehicle and the large obstacles in the terrain create significant reactive forces. Therefore, wheeled dog-horse robots have a different form than conventional vehicles to withstand harsh battlefield conditions and travel through such rough terrain. [4]

### 3.4 Quadrupedal dog-horse Robots

Research on quadrupedal robot platforms is actively being conducted to overcome the limitations of existing wheeled robots. In particular, the military has high utility, and in the United States, various types of quadrupedal robots are being developed with DARPA support, with Boston Dynamics' BigDog, AlphaDog, Cheetah, and Petman being representative examples[5].

"Jinpong" is a 4-legged platform with an engine-mounted hydraulic drive, designed with a target specification of a self-weight of 120kg or less, a load weight of 60kg or more, a maximum walking speed of 1.5m/s on flat ground, and a continuous operating time of 3 hours or more[6].

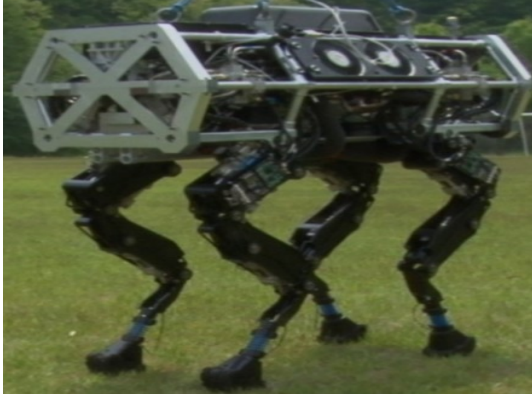
It is being developed with functions such as remote control and autonomous driving, leader following, and can perform transportation, detection, surveillance/reconnaissance, security, guidance, and other tasks on both flat and rough terrain, and is expected to be widely used in both civilian and military applications[6].

### 3.5 Tank Robot

The robot, developed using advanced ICT technology, can overcome the limits of human combat capabilities on the battlefield, and can possess higher combat skills than humans, while also saving training costs[7]. Therefore, advanced countries in national defense are investing heavily in the development of defense robots using advanced science and technology. In defense, robots play a role in solving the dangers of the battlefield and maximizing combat effectiveness[8].

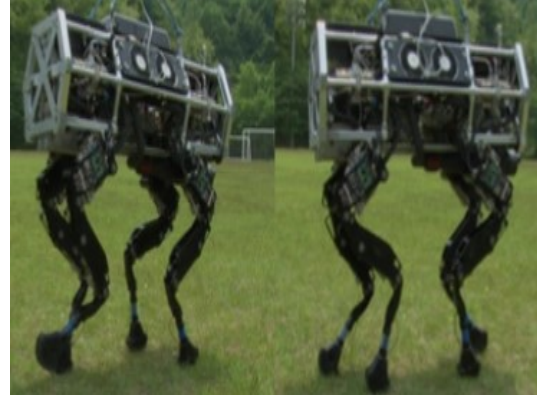
Fourth Industrial Revolution technology will be rapidly and extensively applied to national defense, and the Army is operating a drone bot unit to use robots as weapon systems in future wars. Drone bot is a term defined by the Army, referring to a combination of drones and robots[9]. It is expected to enhance combat effectiveness

and minimize friendly losses by complementing the capabilities of combatants and replacing their roles on the battlefield[9]. In mountainous areas with many obstacles such as trees and steep slopes, unmanned reconnaissance tank robots are needed instead of drones[9].



Source : Jung-San Cho, et al(2012).

**Figure 7. Multi-legged robot(a)**



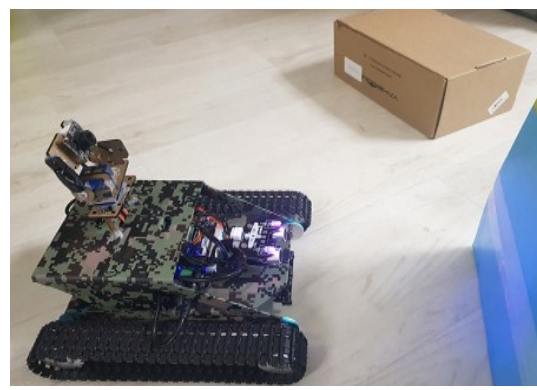
Source : Jung-San Cho, et al(2012).

**Figure 8. Multi-legged robot(b)**



Source : Seung-Woo Kim, Dae-Woo Park(2020)

**Figure 9. Tank robot(a)**



Source : Seung-Woo Kim, Dae-Woo Park(2020)

**Figure 10. Tank robot(b)**

#### 4. DISCUSSION

First, "humanoid robots" will be manufactured in human form and will be operated according to the degree of human control, classified as strong, medium, or weak. The robot is an intelligent combat robot that can perform autonomous combat missions by equipping artificial intelligence to judge and take action on its own in various situations. It will perform independent operations at the same level as human combatants without direct human control or in collaboration with them.

Second, the "semi-autonomous robot" behaves according to the control or manipulation of the human on board, while interacting with the human on board. It is equipped with various weapons and has powerful firepower and defensive capabilities to perform military operations.

Third, the "biomimetic robot" is designed in the form of animals or plants for utilization. This type of robot is naturally well adapted to the environment and can perform covert missions with ease and is also suitable for reconnaissance and striking missions through camouflage. It can also use infrared lasers for target identification



and striking inside buildings.

Fourth, "swarm drones" can enhance lethality by attacking simultaneously in the form of beetles, bees, or bird flocks. Smart dust can penetrate into enemy command posts and buildings, enabling various missions such as eavesdropping, firepower guidance, self-destruction, and cyber electronic warfare.



**Figure 11. Future combat robot(a)**



**Figure 12. Future combat robot(b)**

## 5. CONCLUSION

As we have seen, while developing robot technology, which is the key to the fourth industrial revolution, we need to quickly produce intelligent combat robots that will become a game changer for future warfare and distribute them to the military for military use. In addition, as the value of human life becomes increasingly important on the battlefield, we need to select and develop intelligent combat robots that can replace or collaborate with human combatants, making them a game changer in warfare.

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