The Myth and Reality of the Robot Soldier

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Abstract— Are robot soldiers really science fiction? If you look at today's technologies and robotic advancements, the reality is not far from fact. We are entering a new era of man-kind (and machine-kind). As computers reach unprecedented limits in terms of both processing power and memory storage through massively parallel architectures, quantum computing and smart technologies, autonomous systems are becoming more present. Initially, these systems have be limited to small repetitive tasks (production lines and warehouses), but are now progressing into more general use (self-driving cars and autonomous delivery systems) and we can ultimately see them transitioning into everyday life (machines walking around performing general duties). A particular area that is of concern though, in terms of safety, security and ethical aspects, are robotic soldiers. Drones and unmanned vehicles are already standard tools in today's military for reconnaissance and support. However, as always, there is always the drive to push the limits of what is possible (sometimes ignoring the ethical and moral conundrums), to be the 'first'. Obviously, these robotic solders would be stronger, faster and more agile, they could operate in inhospitable environments or be used to explore new world, they could make the world a safer and better place. Yet, the reality of the fact is, these robotic soldiers also have the ability to destroy the world. Robotic soldiers are not science fiction and are not the problem, it's what these robot soldiers do and become. As autonomous systems develop, growing in complexity and power, with the ability to learn and mimic complex actions - will they introduce unmanageable aspect of security, reliability and trustworthiness.

Index Terms—robotics, soldier, dangers, weapons, artificial intelligence, machine learning, automated, terrorism, war, protection, safety, remote control, ethical, moral, security, support, robots, battles, military, combat, machines, automated

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1 INTRODUCTION

Motivation behind Robotic Agents The benefits and value of autonomous human-like robotics are far reaching with implications for the economy, politics, mobility, healthcare, security and the environment. We cannot deny, human-like robots would take mankind in new unimaginable directions (in every aspect of our life). We often see these autonomous agents performing tedious jobs (cutting the lawn or walking the dog) or tasks that would be dangerous (working in toxic environments), yet we cannot ignore the fact, these agents have other applications (military applications, such as soldiers). This is fine, as soldiers are important. Soldiers do many things, from shooting enemies, to digging defensive trenches. They are used to keep the peace, defend their country or attack another country's army. Imagine robotic soldiers working with or taking the place of human soldiers.

Robotic Agents to Robotic Soldiers Anytime the phrase 'robot soldier' is mentioned, visions of combat and war scenes often come to mind. Every few years, the question pops up in the media, asking where we are with robot soldiers? Will robots work with human soldiers on the battlefield or replace them [1]. Are deadly combat robots rapidly becoming a reality of modern day warfare [2]? It's not just 'robotic' armies but also 'super soldiers' [3] (robotic technologies to enhance a soldier's abilities). Of course, it's hard to predict the future, but without a doubt, we are not going see a 'next' generation of soldier, but a 'new' generation of soldiers (robotic soldiers).

Science Fiction to Fact Obviously, some of the stories and claims around robots taking over the world are a bit far-fetched. Typically, these stories are driven by peoples imaginations (and of course, Hollywood). For example, there is a long list of movies with robots at the centre of their story line, such as,

Terminator, WestWorld, iRobot, Ex-Machina and Chappie, each giving insights into one of the many possible futures.

> *Over time, we can expect human-like robots to become as common as cars on the roads*

Semi-Autonomous Robots While fully autonomous robot are still a few years away, i.e., robots that can make complex decisions for themselves, we are capable of creating semi-autonomous agents that can actively navigate complex terrain and interact with their environment. These robots could work with humans on the battlefield or be controlled remotely. These robots do not necessary have to be in war-like setting either, these human-like robots have many applications in surveillance, exploration, search and rescue, among others.

Unmanned Drones and Robots Akin to the remote-control aerial drones that fill the skies, there could be armies of remote-control land troops. This would result in both unmanned ground vehicle (UGV) and **Unmanned ground agents** (UGAs) which would have the ability to perform reconnaissance or fight battles without any risk or harm to soldiers.

The advancements in human-computer interfaces, e.g., extended-reality (XR), brain-computer interface (BCI) and more, means it's even more viable that soldiers are trained to control 'agents' on the battlefield.

Wrong Hands (Great Power) As with any innovative advancement, it can be used for in the wrong way. We must admit, that autonomous solders introduce a great many risks and dangers. A human-like robotic with great strength and the ability has the ability to cause a great deal of harm. What if an army of ULS fall into the wrong hands? What if they're used for attacking people? What if they're used to police the streets?

Robotic soldiers:

Fig. 1: **Reality of Robotics** - Examples of real-world robotic systems - ranging from 'humanoid' production line workers (left), tank-like drones (middle), through to the more state-of-the-art Boston-Dynamics prototypes (right).

- Faster and Stronger
- Ability to be more flexible and diverse (also possibility of transformation)
- Access to vast amounts of information/training (translate/speak multiple languages)
- Not limited by the human structure (e.g., multiple arms)
- Do not get tired or bored
- They do not question orders
- Extra abilities (x-ray vision,)
- Work in inhospitable environments (e.g., ice-cold climates, such as the North Pole, or even on the surface of Mars)
- They have the ability to work synergistically together with other machines (perfect harmony)

Battles of Tomorrow   Around the world, wars are still fought on the ground. We have to acknowledge that integrating robotic soldiers into these situations would have an impact. We also have to consider the situation, when both sides of the conflict have access to robotics (not just robots in the field but robots vs robots). For example, it's been raised in a number of articles the possiblity of robots fighting robots in future wars [4]. As we would expect, countries such as China are already extensively working on developing this new generation army [5].

AI and Robots   Robotic solders combined with Artificial Intelligence [6] is an interesting union. A machine that is not limited physically (but is able to explore, interact and travel with the outside world). We should also consider how far this 'intelligence' can go - are they limitless? Could they go beyond solving problems embrace higher levels of thinking and creativity (philosophical concepts).

2   WHAT IS HOLDING ROBOTS BACK?

As with with any radically new technology (like self-driving cars) there are conundrums and complications. To name but a few:

- Ethical and Moral Dilemmas (Liability and Responsibility)
- Batteries [7] (long-life batteries/rechargeable)
- AI/computational power (move into the quantum technology era)
- Funding/IP
- Misuse

Imagine a human-like robot serving you coffee in a coffee shop, the reality is, it's totally possible

Human-like Robots Indistinguishable from Real-Humans   As we push the limits of robotics to the next level, we can be sure to see variations of human-like robots that try to mimic humans in every way possible (both physically and emotionally). To the point that a human-like robot would be indistinguishable to another human on the outside (that is it would look and behave in the same way as a real-human being).

Robotic 'structures' are increasing in dexterity and flexibility (matching and going beyond what humans can do, e.g., dancing, climbing and lifting)

Bio-Mechanical Connection   At this level, we are stretching into the realm of theoretical and science fiction when we talk about biological machines - whereby, the computational and mechanical aspects of a robot are not purely 'silicon chips' but are connected and driven by biological components (e.g., organic computers). You have to imagine the extraordinary possibilities, for instance, if a 'human' brain could be directly interfaced (connected) with a robotic system (and vice versa).

Robots and AI won't be the end of mankind, but they'll definitely change the world (for both good and bad)

Public Knowledge (Secret)   Often the case that any advanced military projects will not be made public due to the sensitive nature of the topic. However, we only have to look at the current technologies available to make conclusions of what and what might already be in the early prototype or testing stages.

3   CONCLUSION

Robotic agents, specifically, human-like robots have largely been seen as subjects of science fiction, however, when it comes to the sensitive subject of military and defence, the topic becomes more real. While human-like robots can be created to move in realistic ways, they still lack a lot of the intelligence to make them truly autonomous, not to mention the lack experience for handling complex situations with human-interaction and emotional aspect. We should be very concerned about the real-world possibilities human-like robots will take in the future (AI infused with military grade robotic soldiers could have substantial negative repercussions if ignored).

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