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Robotics in Law Enforcement

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ABSTRACT

Law enforcement agencies have been keeping up with technology for a while now. One tool that is becoming increasingly popular in law enforcement is robotics. The intersection of robotics with law enforcement is revolutionizing policing as we know it. Law enforcement agencies are embracing robotics to bolster their crime-fighting efforts, enhance search and rescue operations, and improve overall public safety. Robots are an increasingly common crime-fighting tool for police and other law enforcement personnel. In this paper, we will delve into the world of developments robotics for law enforcement.

KEYWORDS: *robots, robotics, police robots, law enforcement.*

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INTRODUCTION

In today's rapidly evolving world, law enforcement agencies are harnessing the power of cutting-edge technology to enhance their capabilities. One of the most exciting frontiers in this field is the development of robots for police. The police departments nationwide have increasingly utilized robotic technology to enhance public safety and efficiency. From handing out speeding tickets and patrolling streets to taking down armed suspects and diffusing bombs, robots have become an effective crime-fighting tool that can save both labor and lives. Robots are deployed in high-risk situations such as standoffs with barricaded or armed suspects, aim to reduce the risk to human officers by leveraging smart technology.

WHAT IS A ROBOT?

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 [1]:

- 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.

Although there are many types of robots designed for different environments and for different purposes/applications, they all share four basic similarities [2]:

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 [3].

POLICE ROBOTS

A robot may be regarded as any machine that can collect information, process it, and use it to act upon the world. These qualities vary widely from one robot to another. Robots act upon the world: they can lift objects, transport people, create art, and engage in commerce. Robots can also behave in ways that humans cannot easily mimic. They have crept into every industry, promising to improve performance and increase quality. Police robots might seem unrealistic just a few years ago, but the fantasy is slowly becoming a reality.

Police robots have grown increasingly popular. They assist police forces with everything from surveillance to clearing debris from accident scenes to even detonating bombs. They are designed to help us fight crime, keep the city safe, and improve happiness levels. They can keep officers safe and eliminate some bias in policing. Just as they will change healthcare, manufacturing, and the military, robots have the potential to produce big changes in policing. Police robots may decrease dangers to police officers by removing them from potentially volatile situations. A typical police robot is shown in Figure 1 [4].

Police robots are not too different from other types of robots. The main difference between a police robot and a service robot, for example, is the task they are programmed to carry out. Police robots used by law enforcement and government agencies are programmed to make traffic stops based on driving patterns, use facial recognition to detect criminals and even prevent fraud.

TYPES OF POLICE ROBOTS

A few companies manufacture police robots, and some produce different models based upon the needs and resources of different police forces. No two models are exactly the same, but most models share basic features and functions. If the robot is not tethered to a power source with a cable, it needs an onboard battery. The companies that manufacture robots for police forces know that their product has to work within a wide range of conditions. The following are the common types of police robots [5]:

- *Dog Robots*: Robot police dogs, particularly deployed in high-risk situations such as standoffs with barricaded or armed suspects, aim to reduce the risk to human officers by leveraging smart technology. In the US, robotic dogs are being used by the NYPD and LAPD. The NYPD reintegrated dog robots into their operations. This showcases real-life applications of robot dogs, from critical incident interventions to boosting law enforcement capabilities with these technological advancements, providing insight into the evolving landscape of policing. In New York City, the NYPD deployed a non-human-looking robot at some of the subway stations and already received a good amount of pushback. Honolulu (Hawaii) Police Department is primarily using its robot dog for humanitarian purposes [6]. A typical dog robot is shown in Figure 2 [7].
- *Patrol Robots:* Some police departments are deploying autonomous patrol robots that can navigate predefined routes, check for suspicious activity, and alert officers when intervention is required.
- *Swarm Robots:* Imagine police robots that could surround a suspicious person or even halt a speeding car. This might take the form of a swarm of small robots, each less than a pound, designed to incapacitate a person by surrounding him and by using nonlethal force. Consider further that such a swarm would be capable of using some form of coercive force to prevent an unwillingly detained person from flight.
- *Teleoperated Robotics*: This is the application of robots or robotic systems remotely controlled by a human operator. Teleoperated robotics can be equipped with specialized tools and sensors to detect and handle hazardous materials with precision and efficiency. It has proven impactful in a variety of professional fields such as medicine and law enforcement. Teleoperated robotics is going to empower officers to remotely control advanced robots equipped with cameras, sensors and haptic feedback technology, significantly enhancing officer safety without risking their lives. By minimizing direct physical interactions in potentially dangerous

environments, this technology significantly reduces the risk of harm to officers and community members, creating a positive perception of safety. To successfully implement teleoperated robotics in law enforcement, it is important to prioritize transparency, stakeholder engagement, accountability and funding.

- *Humanoid Robot:* The robotic cop can interact with people verbally. Humanoids require much more training before they are ready to operate autonomously in the real world. India added a humanoid robot to the Kerala Police Headquarters. The robot, called KP-Bot, was developed by the Indian startup Asimov Robotics and the police research centre Cyberdome. It is battery-powered and can operate for eight hours on a single charge. The robot is stationed at the front desk in the police headquarters, where it receives visitors and directs them to the right department. The humanoid robot is shown in Figure 3 [8].

APPLICATIONS OF ROBOTICS IN LAW ENFORCEMENT

Law enforcement agencies are increasingly using robots for a variety of tasks, from surveillance and bomb disposal to patrolling and even potentially deploying force. Common uses of robots in law enforcement include the following:

- *Bomb Handling:* Law enforcement agencies have used robots for many years for functions such as remotely disarming bombs. Robots have long been used to safely handle and defuse explosives, allowing officers to remain at a safe distance. Robots can detect whether a bomb is in a specific area and dispose of it without having any humans risking their lives. They can also train bomb disposers of risks without subjecting them to the risk per se. Hundreds of robots—most of them made for bomb disposal—are already in the possession of local police departments. Many such robots will soon employ artificial intelligence and will be expected to operate with a degree of independence. Figure 4 shows a 50-pound robot, Fido, which sniffs out bombs [9].
- *Search and Rescue:* When a structure collapses, or significant catastrophes happen, robots can go to this dangerous area to locate victims. Additionally, they can take wounded personnel out of hazardous situations. Police search and rescue robots (SAR) are being used in rescue situations, such as damaged buildings after a disaster that are unsafe for a first responder to enter and in attempts to find and rescue victims. It is only been recently that robots have been developed for search and rescue, as GPS and thermal imaging was added to the arsenal available to robots. The SAR would step up and make the rescue, using its own bulk to protect the person being rescued. The most important function of a SAR robot is to relay back information to the rescuers, from the exploration of the area while locating survivors.
- *Surveillance:* Most robots are only used for surveillance and monitoring. By far, gathering and relaying information are robots' main tasks within law enforcement. Robots can also be used as a surveillance device. A robot with microphones and night vision can approach a potentially unsafe area while broadcasting information back to the operator. Using a robot can help reduce the time it takes for police to assess a situation, without placing an officer at risk. Another benefit is that the robot's cameras can continue gathering information while police use the audio system to communicate with people in dangerous situations. Surveillance and privacy researchers say there are few restrictions on robotic surveillance in many communities. There are also concerns that lower-income areas and people of color will be overpoliced and over-surveilled by the robots. Besides robotic dogs in law enforcement, the NYPD also tests Knightscope K5. The human-sized robot is equipped with cameras, sensors, and speakers. It is meant to patrol and surveil its surroundings, deterring break-ins and vandalism. The robot is shown in Figure 5 [10].
- *Patrolling:* As for policing, Dubai plans to introduce patrol robots with artificial intelligence to its streets by 2020. The Chinese AnBot can independently patrol, and upon a remote operator's command, use its mechanical arm to grab people. Equipped with infrared cameras, microphones, and license plate readers, the American Knightscope security robot can patrol independently, for $7.00 an hour. Robots like the Knightscope K5 are used for autonomous patrolling and surveillance, particularly in areas like parking garages and public spaces. As shown in Figure 6, robots patrol alongside Singapore Police Force frontline officers and serve as additional eyes on the ground [11].

BENEFITS

Fully autonomous, AI-driven robots have become essential tools for enhancing safety and operational efficiency in law enforcement, marking a significant evolution in police capabilities. Robotic policing could yield potentially big benefits for equity, privacy

and safety — for both police and drivers. Police robots may not have badges, but they know how to get the job done. Although police robots are not writing speeding tickets, they are stepping into plenty of other important jobs. Other benefits of police robots include the following [12]:

- *Enhanced Safety:* The main advantage of a robot over a human is that physical danger no longer matters. Police robots can handle the dangerous and tedious jobs that human officers would rather avoid — like disarming bombs or sneaking around on surveillance missions. They can take on dangerous tasks, reducing the risk of injury to officers. They are designed to make stops, arrests, and other intense situations less dangerous. Robots handle explosives so officers do not have to. They inspect, disarm, and transport dangerous devices, making sure everyone stays safe. For example, Spot has also helped German fire and police officials to investigate the ruins after a major fire in Essen. Technological advancements like Spot enable us to resolve dangerous situations quickly and safely.
- *Increased Efficiency:* Robots can perform tasks faster and more efficiently than humans, particularly in repetitive or hazardous situations. Robots do not get tired, take coffee breaks, or call in sick. They handle repetitive and high-risk jobs all day, every day. Robots do not have to take breaks, which allows them to be available for duty for extended periods of time. This also makes them an asset when it comes to completing repetitive tasks and assisting in surveillance, such as patrolling an area or quickly identifying potential suspects in a crowd.
- *Reduced Ticketing:* Combining robotics with self-driving technology could allow for police vehicles with the ability to autonomously flag down drivers and write traffic violation tickets — all without a police officer present. Some propose that this can reduce police stops on the road that are due to filling ticket quotas, or maybe just due to human suspicion.
- *Remote Communication*: Robotic devices equipped with cameras and speakers allow officers to communicate with individuals in potentially dangerous situations remotely, reducing the risk to both law enforcement and civilians.
- *Bomb Removal:* Police have the option to robots in several situations. The most common use for a police robot is in bomb removal and disposal. While robots are expensive, the cost is small compared to that of human life. Some robots are so tough that they can survive multiple blasts. When investigating a potential bomb, police officers use the cameras on the robot to assess the situation.

CHALLENGES

While robots offer potential benefits like increased safety for officers and enhanced situational awareness, they also raise concerns about accountability, potential bias, and the future of policing. Even when companies can meet all the technological demands of an autonomous, armed police force, there will still be social and political hurdles. Other concerns and challenges include the following [12,13]:

- *Bias:* Scientists, researchers, and policymakers have also raised questions around the potential for racial or ethnic bias. While robots might not have an inherent racial bias, for example, that does not mean the underlying AI technology is perfect. People with dark skin are misidentified by facial analysis software far more often than their lighter-skinned counterparts. Some of these police robots employ that sort of technology. Those who already are more likely to be targeted by police are least represented, which puts them at higher risk of being misidentified as a criminal suspect. We do not want a system prone to bias going around with the capacity to kill people.
- *Limitations:* Police robots are not autonomous. They cannot think for themselves or make decisions; a police officer controls every move remotely. The robot may be wireless or may have a cable tethering it to a power or control station, as typically shown in Figure 7 [13]. Robot command and control centers are portable, allowing officers to set up a station a safe distance away from where the robot will carry out its duties. Robots might act too forcefully in situations that call for nuance and restraint. It can be difficult to determine who is responsible when a robot makes a mistake or causes harm. Robots are expensive to purchase and maintain and require an officer's input to function.
- *Privacy:* Privacy is one of the reasons why the NYPD initially stopped using robotic dogs in their patrols and such. Despite these concerns, there still have not been any incidents in which a machine has malfunctioned or compromised anyone's privacy.
- *Security:* Another concern is the security of the robots themselves. Given that machines are hackable, some people are concerned that

cybercriminals could hack into these machines and use them to cause more problems to society. While there have been no such incidents to date, these robots are also built with adequate cybersecurity measures to ensure they cannot be easily compromised.

- *Public Trust:* The use of robots in law enforcement can erode public trust, especially if they are perceived as overly aggressive or intrusive. Police robots raise special questions because of the powers we entrust to the police. If the development of military robots provides any guidance, then we can expect some police robots to be artificially intelligent machines capable of using legitimate coercive force against human beings. We will not expect police robots to exercise deadly force against a hostile enemy. More importantly, constitutional law and democratic norms constrain the police. The possibility that some robots capable of hurting or killing people will be capable of complex, independent action raises concerns. Police departments are currently discussing the use of killer robots in extreme circumstances only. The idea of robots being legally allowed to kill has garnered some controversy. This highlights the questions of if, when, and how to use lethal autonomous weapons systems. Figure 8 shows campaign to stop killer robots [14].
- *High Cost*: Sophisticated and inexpensive robotics will be attractive to the police just as they have been to the military. The federal government is already spending significant amounts of money and attention on robotics research.
- *Regulation:* How we design, regulate, or even prohibit some uses of police robots requires a regulatory agenda now to address foreseeable problems of the future. The regulation of police robots will prove to be especially difficult because robots will likely be adopted and regulated much like other recent police technologies: in an ad hoc and decentralized manner.
- *Weaponization:* There are growing concerns about the potential for robots to be weaponized, which could have serious consequences. Over the past decade, increased incidents of active shooters, terrorist attacks, suicidal individuals, and assaults on officers have heightened public safety threats. These situations demand prompt responses but also endanger officers and communities. It is crucial for law enforcement to adopt new and innovative solutions to address these challenges.

CONCLUSION

The integration of robotics in policing is a game-changer for law enforcement agencies worldwide. The police robot has earned its spot on the force by taking on dangerous, repetitive, and time-consuming jobs. These bots make law enforcement safer, faster, and more effective. They enhance safety, improve response times, and enable more effective crime prevention and investigation.

Robotic policing is the future of law enforcement agencies. Imagine a future in which robots could supplement or replace some basic police functions. As these technologies continue to evolve, they will play an increasingly vital role in ensuring public safety and effective policing. In the future, robots might be more autonomous, eliminating the need for a human operator calling the shots from a command console. More information on robotics in law enforcement can be found in the books in [15,16] and the following related journals:

- Robotica
- Robotics
- Robitics and Autonomous
- Robotics and Computer-Integrated Manufacturing,
- Advanced Robotics
- Autonomous Robots
- Automation in Construction
- 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 Robotics Research
- International Journal of Social Robotics
- International Journal of Humanoid Robotics
- International Journal of Advanced Robotic Systems
- Science Robotics
- Soft Robotics

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Figure 1 A typical police robot [4].

Figure 2 A typical dog robot [7].

Figure 3 Indian humanoid robot [8].

Figure 4 A 50-pound robot, Fido, which sniffs out bombs [9].

Figure 5 The K5 NYPD robot [10].

Figure 6 Police robots go on patrol at Singapore airport [11].

Figure 7 A robot may have a cable tethering it to a power or control station [13].

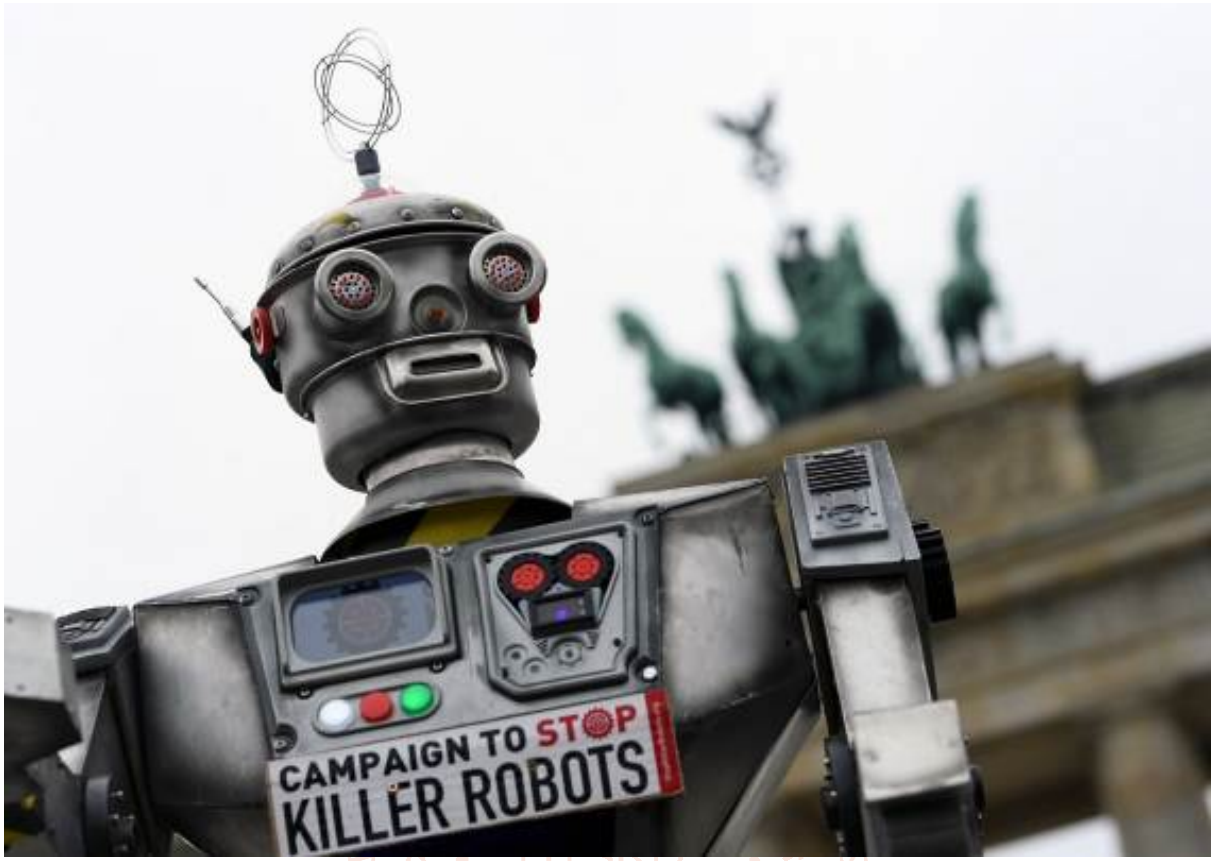

Figure 8 Campaign to stop killer robots [14].

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