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Robots in Policing

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Abstract. This article is devoted to the question of how robots are used in policing and what opportunities and risks arise in social terms. It begins by briefly explaining the characteristics of modern police work. It puts service robots and social robots in relation to each other and outlines relevant disciplines. The article also lists types of robots that are and could be relevant in the present context. It then gives examples from different countries of the use of robots in police work and security services. From these, it derives the central tasks of robots in this area and their most important technical features. A discussion from social, ethical, and technical perspectives seeks to provide clarity on how robots are changing the police as a social institution and with social actions and relationships, and what challenges need to be addressed.

Keywords. Policing, Service Robots, Social Robots, Social Relationships, Ethics

1. Introduction

Different robots are used in policing. They detect conspicuous movements and activities, perceive suspicious noises and hazardous substances, and defuse bombs. They inform and control passers-by or accompany police officers on operations. They are in the air, as drones, or on the ground, or even in the water. The majority of these machines can be qualified as service robots. Some of them are social robots. Private security services also draw on the capabilities of robots—or are even replaced by them.

The police can be understood as a special social institution. Social life takes place in their teams themselves, and professional hierarchies are applied. Their work is social work in multiple senses. They encounter the general population, along with suspects and criminals and their friends, relatives, and neighbours. They research not only databases and search systems, but also social media, and they gain access to personal records and images on computers and smartphones, where technically and legally possible.

The following research question leads on from this: How are robots being used in policing and how are they changing it? To answer this question, the article begins by briefly explaining the characteristics of modern policing. It puts service robots and social robots in perspective and outlines relevant disciplines. The article also lists types of robots that are and could be relevant in the present context. Then it gives examples from different countries where robots are used in policing and security services. From these, it derives the key tasks of robots in this area and their key technical characteristics. A discussion from social, ethical, and technical perspectives attempts to provide clarity on how robots are changing the police as a social institution including social actions and

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relationships, and what challenges need to be addressed. This aspect has been poorly covered by the literature. An outlook addresses issues and problems for the future.

2. Basics of Modern Police Work and the Use of Robots

2.1. Basic Features of Modern Police Work

As part of the executive branch, the police are supposed to ensure or restore public safety and order. As a law enforcement agency, they pursue criminal and disorderly acts, whether these take place in 'real' or virtual space. They are also responsible for averting domestic security threats. One special task is monitoring compliance with traffic regulations. The police are not bound by the rule of law in all states—rather, they are sometimes the extended arm of a totalitarian government or are characterized by corruption due to other influences. Generally, the police are allowed to use force if it is justified. However, police violence is sometimes considered a criminal offence.

Modern police work is characterized by teamwork and internationality and is based on scientifically developed methods and findings. Those in charge use computer- and Internet-based technologies and media to obtain information, monitor communication tools and suspects, and—via access systems, for example—establish public safety and order. Artificial intelligence systems—in other words, 'predictive policing'—and robots are playing an increasingly important role [1, 2]. Of course, a distinction must be made between different departments within the police—but modern technologies are used in all of them.

As already explained, the police are a social institution in a stricter sense. At its best, it aims at social cohesion, and it has social structures itself. Police work is made up largely of office work and patrol duty [2, 3]. In patrol duty, the use of computers and robots is becoming increasingly important. In addition, some police operations are only taking place at all because the results of predictive policing have shown the need for action. When in contact with the civilian population, it can be important for a police officer to be seen as a person of authority while also appearing trustworthy. Symbols such as uniforms and police cars that are easy to recognize and appear respectable are helpful in this regard.

2.2. Service Robots and Social Robots

Social robots are sensorimotor machines created to interact with humans or animals, particularly more sophisticated species [4]. They can be identified by five key characteristics. These are: interaction with living beings, communication with living beings, proximity to living beings, representation of (aspects of or features of) living beings (e.g., they have an animaloid or a humanoid design, or natural language abilities) and, fundamentally, utility for living beings. A broad definition includes software robots as well as hardware robots, and so could include certain chatbots and voice assistants, relativizing the sensorimotor aspect.

In policing, robots can look similar to humans and replace or accompany police officers. They can also resemble animals and replace police dogs. Sometimes they are designed to be 'thing-like', in which case they may have social capabilities. In all cases, they get close to police officers and civilians, interacting and communicating with them, creating new social relationships.

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Some social robots are service robots, that is, they handle certain services and provide certain assistance, and conversely, some service robots are also social robots, insofar as they have communication and interaction functions. Typical examples in this intersection are care and therapy robots, and information and advisor robots in public spaces.

Robotics is the discipline responsible for industrial and service robots. For social robots, social robotics has emerged, which collaborates with sociology, psychology, and philosophy, among others. Social robotics crosses over with machine ethics. Moral and immoral conversational agents have emerged from this discipline in recent years [5].

2.3. Relevant Robots in Police Work

The following section presents robot types that have or can have relevance to police work. In doing so, it draws on common classifications of service robotics [6], which are adapted to the given context, and additionally includes the general-purpose robot, which bridges the gap between service robotics and social robotics even more than other examples. In each case, design and characterization are addressed in addition to the task.

- Information and advisory robots, as well as navigation robots, drive or walk through parks, streets, across squares and grounds or through museums, trade fairs, and salesrooms. They inform citizens, visitors, and customers about large-scale police operations and dangerous situations such as gatherings and demonstrations and guide them to or away from a specific location. They are mostly autonomous, often humanoid in design, and the majority can be understood as social robots.
- Security and surveillance robots relieve or replace police units and security forces and ensure the security of companies and individuals, for example by reporting conspicuous situations or requesting people to keep their distance. They are (partially) autonomous or are brought to or controlled and activated at operation sites. As ground robots, they sometimes resemble cones or related forms, or else small vehicles. As flying robots, they are mostly quadrocopters. A few are humanoid and can be classified as social robots.
- Combat, demolition, and clearing robots are used in police operations or in warlike conflicts for the diversion of resources, the reconnaissance of bases and locations, and the observation or removal of threats (such as defusing bombs and mines) and opponents. They are controlled remotely or else are semi-autonomous or even autonomous machines. When they replace soldiers, they can be considered social robots, although this classification is always a source of irritation because the concept of social has a certain ambiguity here. Demolition and clearing robots, on the other hand, are classic service robots.
- Cleaning and disinfection robots help with the wet cleaning of surfaces, e.g., after a homicide, or with the disinfection of surfaces and objects. Cleaning robots can also be used for dry cleaning floors, especially as vacuuming robots, or as sweeping robots for streets and sidewalks, for example after an accident. You take them to a job site and leave them to their own devices for a period. They are usually plain in design and resemble flat cylinders or cuboids.
- Transport robots carry items of all kinds from one party to another. They relieve or support police courier services within buildings or between facilities. They

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may also be suitable for transporting hazardous materials. They are (partially) autonomous or are guided from place to place by humans or other machines for loading or unloading. They are designed in a 'thing-like' fashion, but may have social features, such as eyes and mouths for miming capabilities.

- General-purpose robots are robots that have strengths either in natural language communication or—as bipedal or quadrupedal or rolling devices—in their mobility and motor skills. They are not assigned to a specific service and in this limited sense are to be understood as generalists. Thus, in principle, they would be suitable for patrol duty and missions of all kinds. They are often animaloid or humanoid in design and most of them are social robots.

The types show how service and social robotics are intertwined. The majority of these robots have either selected social capabilities or the entire spectrum of a social robot, i.e., they fulfil all dimensions, to take up the above expression. The list is certainly not exhaustive. It will also change as robotics and policing evolve. Concrete examples in practice—this will become apparent in the next section—may include several types. This will also clarify which robots are already in frequent use and which are not.

3. Examples for Robots in Policing

This section provides examples of service robots and social robots in police use. The selection is based on research in the media and in scientific literature. It is intended to show examples of how diverse and varied the use of robots is in this context.

3.1. Spot in Singapore

According to a 2020 report from Singapore's top government technology agency, Spot from Boston Dynamics reminded visitors at a park that they should follow social distancing guidelines. It is a four-legged model reminiscent of a large dog that can move quickly and nimbly and—not least because it lacks a head—appears scary. It can be considered a general-purpose robot and a security and surveillance robot. "Spot was made available for purchase by businesses and governments last year and has specially designed cameras to make sure it doesn't run into things." [7] The cameras were not capable of tracking or recognizing specific individuals, and it would not collect personal data [7]. The robot was accompanied by chaperones, as photos suggest.

3.2. Spot in New York

In New York City, the New York Police Department (NYPD) brought Spot, named Digidog, into an apartment building in the spring of 2021 as part of a mission. It can be considered a general-purpose robot in the defined sense here. The operation resulted in the arrest of an armed man. Futurism magazine reported: "The robodog may not have played an active role in the arrest but having an armed police squadron deploy a robot to an active crime scene raises red flags about civil liberties and the future of policing." [8] Subsequently, there were voices condemning Spot's presence. The New York Police Department therefore initially refrained from further deployments of this kind but made hints about resuming the project [9].

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3.3. K5 in Silicon Valley

K5 from Knightscope is used on company premises, in shopping malls, on squares, and in other (partially) public areas. It can be classified as a security and surveillance robot. It is cone-shaped in the classic version, with a less regular form in a newer version, and can 'see' (also in combination with facial recognition), 'hear', and 'smell'. It moves autonomously around on rollers. The newer model has natural language capabilities. Looking at its deployment in Liberty Village, an apartment complex on the northeastern edge of Las Vegas, the company touts that it has significantly reduced the number of emergency calls. However, an officer of the Las Vegas Metropolitan Police Department is sceptical of this and suspects multiple causes [1].

3.4. Demolition Robots in Germany

Robots like the Husqvarna DXR series are used time and again in the US and in Europe. They belong to the group of combat, demolition, and clearing robots. In Germany, the Wehrmacht already had demolition robots during World War II [10]. The models are mostly tracked vehicles and resemble small tanks. As remote-controlled devices, they can inspect, open, and blast suitcases. They are equipped with cameras and various sensors, as well as grappling arms and tools. In 2016, a robot of this type was used by a police unit to kill a suspected sniper in Dallas. In that instance, it was brought to him instead of defusing a bomb.

3.5. REEM in Dubai

At Expo 2020 in Dubai, the humanoid REEM from PAL Robotics was used by the police for customer service [11]. It can be classified as an information and advisory robot. It wears the same green uniform and cap as the human officials. To greet them, it extends its three-fingered hand or salutes. It is capable of facial recognition in combination with emotion recognition as well as gesture recognition. The robot moves autonomously but can also be controlled remotely. It has a touchscreen at chest level. Citizens and visitors can use it to place advertisements or call up information electronically. Via video link or voice connection, officers in the control room contact them directly and receive live images [11]. No information can be found about the actual deployment during the Expo, which took place from October 1, 2021, to March 31, 2022, because of COVID-19.

3.6. O-R3 in Dubai

A 2017 report said that O-R3 from OTSAW Robotics in Singapore was to be deployed in Dubai [12]. According to a press conference, the police chief was looking forward to the collaboration. The police vehicle can be classified as a security and surveillance robot. It is equipped with laser scanner, thermal imaging camera, and lidar. Inside, it carries a drone that can be controlled from the police headquarters. O-R3 also allows phone calls between people and the police station connected to it. In fact, it appeared during the COVID-19 pandemic as an information and advisory robot: "Originally used for surveillance, this robot was redeployed as a safe distancing ambassador during the circuit breaker period last year. Developed by local technology company Otsaw, O-R3 patrolled Bedok Reservoir daily in the mornings and evenings, broadcasting safe distancing messages." [13] Such reappropriation occurred in many cases during the pandemic [14].

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3.7. Xavier in Singapore

Singapore's Home Team Science and Technology Agency (HTX) has deployed Xavier in the streets of Toa Payoh Central as part of a trial to help officials improve public health and safety. Xavier can be classified as a security and surveillance robot. Like O-R3, it is a vehicle, with four wheels and a body that contains the camera, among other things, but looks smaller and sleeker. "The robot ... was jointly developed by HTX and the Agency for Science, Technology and Research. It is fitted with sensors for autonomous navigation, a 360-degree video feed to the command and control centre, real-time sensing and analysis, and an interactive dashboard where public officers can receive real-time information from and be able to monitor and control multiple robots simultaneously." [15] Xavier's intercom system allows officers to respond to incidents remotely [15].

3.8. Drones in China

In China, during the pandemic, people travelling without protective masks were tracked down via drones and vocally reprimanded. The drones can be seen as security and surveillance robots. These were probably isolated activities, partly possibly carried out by influencers [16]. The videos, some of which were made directly by the photo drones, were in several cases subsequently edited, for example with sound effects added. Remote-controlled quadrocopters are usually used for such missions, and specified routes can be flown automatically. The voice is live or recorded. Reactions have been mixed. While some see it as further evidence of the encroaching surveillance state, others believe it is a useful measure to curb the COVID-19 epidemic [16]. Some of those caught perceived the drones as a direct threat, as can be seen from their expressions.

3.9. KP-Bot in India

In India, KP-Bot is being tested at the reception desk of a police station. It can be classified as an information and advisory robot. It is humanoid, has a display in the chest area and can salute. In a photo circulated by the Asian News International news agency, it wears a brown police cap—like an Indian official. It was reportedly promoted to the rank of sub-inspector in 2019. "Aside from the symbolic gesture of integrating robotics into the police force, KP-Bot doesn't do much. At the moment, it can sit behind a police station's front desk, recording complaints and directing visitors to the correct department as needed. [...] In the future, it may be integrated with facial recognition software or the capability to detect bombs." [17]

3.10. Purposes and Characteristics of the Presented Examples

Most of the examples show the use of security and surveillance robots as well as information and advisory robots, and how these activities often merge in practice. Moreover, there were examples of blasting and general-purpose robots. The situation was less fruitful for cleaning and disinfection robots, and transport robots—however, little is reported about these types, which are considered less attractive and interesting. In addition, it may be that automation in this area is currently still causing more harm than good, or that the legal situation is unclear.

With several robots, cameras are used in conjunction with face recognition and facial expression or gesture recognition. They largely move on rollers—only Spot stands out

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because of its increased mobility on four legs. This enables it to be carried along on missions like a police dog. The design is often humanoid when the robot is supposed to interact or communicate with humans. In addition, natural language capabilities are always present. These characteristics belong to social robots, as explained at the beginning. There is likewise repeatedly a 'thing-like' shape, in some cases adding social features such as natural language abilities.

It is noticeable that prototypes and collaborations are repeatedly announced in the media, but an actual use cannot be proven in every case. Companies send out media releases early and compliantly, without following up or updating later. This contributes neither to the credibility of the media nor to that of the companies and operators. Admittedly, in some cases, the purpose has simply shifted due to changed circumstances.

4. Discussion of Robots in Policing

This section presents a discussion of the use of robots in policing—also understood as social work—from a practical and social perspective as well as from an ethical perspective. The basis is the structures and findings developed in advance. It may be objected that some descriptions of problems are anecdotal. However, systematic studies in this area are hardly available, and even individual cases are interesting and suitable for tentative conclusions. Technical developments and considerations directed toward them are included in passing.

4.1. Practical and Social Challenges of Integrating Robots into Policing

4.1.1. Stirring up Fears among the Population

The NYPD's Digidog has shown that certain robots arouse fears among the population, through their use per se, but also through their appearance. First of all, a usual encounter in social space takes place under altered conditions. People who can assess each other and communicate with each other in the usual way are joined by a robot. This changes or disrupts the relationship. In addition, the robot resembles a large dog and appears scary and unpredictable. Some individuals referred to Digidog as emblematic of police aggressiveness when dealing with poor communities [9]. Overall, the deployment can be perceived as arming with inadequate means and as an intimidation tactic.

4.1.2. Damage to Symbols of the Police

Several robots like REEM in Dubai or KP-Bot in India were equipped with symbols of the police, such as a uniform or cap. In another context, an airline had Pepper wear the flight attendant uniform but this did not go down well with the employees. They felt deprived to some extent of what they were proud of and could identify with [4]. Police officers could also react in a negative way. Recognition and support for respect play a special role for them and can even be decisive and vital during operations. Damaging the symbols would be counterproductive. In addition, the symbols were primarily used to depict male police officers, which could cause female police officers to feel underrepresented.

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4.1.3. Damage to the Social Fabric of the Unit

Not only symbols, but also social structures in a police unit could be damaged. In operations such as the case of Spot in New York, it is obvious that the police officers' attention was strongly focused on the robot. This may not only make it more difficult to perform tasks properly, but also to cooperate and collaborate within the team. It is possible that this will weaken in the future when the integration of the robots has become a matter of course. One day, fears of being replaced may arise—which is hardly to be feared given the immaturity of current technology. However, a robot can be just as much a unifying element that officers in the unit talk about, are proud of, and have a recognition effect within the police force and in the public.

4.1.4. Immaturity of the Technology

Some of the robots like REEM in Dubai are not technically mature or complete with regard to their application and can only be used to a limited extent for police work. With rollers, they are unable to get everywhere; with otherwise limited mechanical capabilities, they can only provide limited support to citizens and tourists or to police officers themselves. Communication capabilities are also not consistently such that queries are always answered satisfactorily. This is true for almost all chatbots, voice assistants, and social robots, whether they are based on a fixed knowledge base, matching of previous conversations, or machine learning. A lack of functionality, coupled with unreliability and misinformation, can damage the reputation of the police and the work itself. It can also affect public acceptance.

4.1.5. The Enemy Image of the Robot

Police officers are highly respected in many countries, but in some they are known for corruption and abuses. Overall, they are losing more and more respect and status as authorities in Western democracies [18]. If they used Spot, K5, etc., such sympathies and antipathies could be transferred to them. In this way, service robots and social robots could be perceived as a problem, which—if designed and deployed appropriately—they are not necessarily. This could make work more difficult in other areas where they are urgently needed, such as transport and cleaning or care and therapy. Both service robotics and social robotics could suffer.

4.2. Ethical Challenges in the Use of Robots in Policing

4.2.1. Responsibility and Liability

If robots perform or support actions during a police operation in which people are harmed (by accidents or automatically triggered weapons as in the case of demolition and clearing robots), or if they give false information that has serious consequences, the question of responsibility and liability arises [19]. The fact that robots cannot bear responsibility in a moral sense has been elaborated many times [20, 5]. At most, they could exercise liability under civil law as special legal subjects—e.g., as special forms of electronic persons, which in turn were conceived along the lines of legal persons [21]—for example, by settling a claim from a fund associated with them. However, this raises the question of whether they are singular systems or linked to other systems—if the latter is the case, there are multiple electronic persons, which makes damage compensation difficult.

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4.2.2. Privacy and Informational Autonomy

Service robots and social robots have repeatedly been portrayed as spies in the literature [22]. With the help of cameras, microphones, etc., combined with facial, gesture, voice, and emotion recognition, they can invade privacy and violate informational autonomy. This can be defined ethically and legally. Basically, it is about having knowledge of data flows and being able to view, track, and correct personal data if necessary—for example, if personality rights are violated. Public suspicion of the police could be aroused by the use of robots, which potentially or factually interfere with informational autonomy (as in the case of K5 and Xavier or the drones in China), in a similar way to body cams, which are also questionable. A specific concern is the bias that can arise with facial and behavioural recognition systems [19].

4.2.3. Imbalance of the Parties Involved

When service robots and social robots like REEM or O-R3 in Dubai interact and communicate with the population, and with suspects and convicts, a certain imbalance arises, because the people concerned usually do not know what functions are available or what data is being generated and forwarded, just as little as whether the robot is connected to a person who, at the same moment, gains his or her insights and draws his or her conclusions. This imbalance also occurs when there is no communication but monitoring, possibly with the help of artificial intelligence [6, 23]. The observed does not know the observer, his or her possibilities and systems, or what the latter can exploit. The imbalance of one kind or another is ultimately connected with a power imbalance.

5. Summary and Outlook

The research question of this paper was: How are robots being used in policing and how are they changing it? Police work was also understood as social work. Above all, it became clear that robots can disturb the relationship between the police and the population. Some of them are perceived as threatening, others as inadequate. The reputation of the police can be affected as much as that of the robots. There may also be changes in the fabric of policing units. On the one hand, there is potential because a new member is present who is special and can be talked about. One can even speak with it if it has natural language abilities, and thus promises an extension of social life. On the other hand, routines are disrupted and symbols are damaged.

Overall, empirical evidence on social change in the police is still lacking. There is a lack of accompanying studies and systematic processing of the experiences. Science and police need to collaborate more here. On the science side, robotics, social robotics, psychology, and sociology need to be involved, which is not difficult organizationally or institutionally, since these disciplines work together anyway.

In the future, other issues such as autonomous decision-making by armed robots will need to be addressed [19]. Again, there will be social shifts and tensions, and intense debates, as with military robots [5]. Ethical and social science perspectives are crucial here. Ultimately, it may even be examined whether increasing mechanization and robotization will mean the end of policing in its current form [2, 24].

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