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*Commentary*

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# Containing COVID-19 in China: AI and the robotic restructuring of future cities

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**Abstract**
COVID-19 has generated interest in the potential of urban robotics and automation to manage and police physical distancing and quarantine. This commentary examines the intersection between COVID-19 management strategies and the technological affordances of robotics, autonomous systems, and artificial intelligence (AI) in urban pandemic control. Examples from China illustrate the possibilities for urban robotics and automation in a new era of urban bio-(in)security.

**Keywords**
artificial intelligence, COVID-19, pandemic control, robotics, urban

## Introduction

A defining feature of the effective management of COVID-19 is the need for stringent non-pharmaceutical strategies including physical distancing, lockdowns, and quarantining to block transmission of the SARS-CoV-2 virus between humans (WHO, 2020). However, strategies are also required to facilitate the movement of people and material to maintain essential circulatory flows and sustain human life. In this commentary, we examine the intersection between COVID-19 management strategies and the technological affordances of robotics, autonomous systems, and artificial intelligence (AI) to reduce the need for human contact in selected areas of urban interaction.

The COVID-19 pandemic is unfolding at a time of ongoing and significant advances in urban robotic applications. Drawing on examples from China, we examine how responses to COVID-19 have broadened the landscape of robotic infrastructure and what might be learned about the prospects for future

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urban robotic restructuring. For example, are these experiments in urban robotics a viable rather than speculative framework for public health and urban management? Are these new capacities simply temporary expedients or part of an emerging model of technically augmented biosocial management? If the latter, what does it mean for the extension of surveillance and social control in urban environments that are now seen as hostile to humans? In addressing these issues, we draw on emerging theory which points to growing concerns and public scrutiny over new forms of automated social control (While et al., 2020).

## Robotics and pandemic urbanism

There were major advances in real-world applications of urban robotics around the world prior to the coronavirus outbreak, evidenced by the rapid development of drones, driverless vehicles, and service robots (Macrorie et al., 2019; While et al., 2020). Governments and private firms were the primary driving force, with the former more interested in automated policing and traffic management and the later focused on transforming freight and human mobility. A robotic infrastructure is particularly well placed to respond to the containment and physical distancing logics of virus management. Indeed, one of the most significant advances in robotic applications has been in 'hostile' environments where it is difficult for humans to function safely. COVID-19 turned the outdoor public realm into a potentially challenging environment for humans. Potential intersections between robotics and urban COVID-19 management include:

*Reducing human-to-human contact:* urban robotics is in part a method for substituting humans on the grounds of efficiency, reliability, and cost savings as well as extended capability in logistics, healthcare, and social services. Robots can perform and replace key 'human' functions in urban pandemic control, either autonomously or controlled at a distance, to minimize the risk of disease transmission.

*Managing, monitoring, and controlling movement:* a central task of territorialized COVID-19 management has been to control movement and enforce lockdowns through human policing and mobile phone-based tracking. Robotics and AI —including facial recognition software—offer new forms of territorial control in the sky, on the ground, and at checkpoints.

Prior to COVID-19, robotic applications in the public realm were limited by concerns for public safety, albeit with limited discussion of surveillance and social control (While et al., 2020). Those concerns remain but there is perhaps now a more permissive approach to urban robotic experiments, reflecting new calculations of human risk and extending the scope and scale of experimental applications.

## Robotics and COVID-19 in China

By 2019, China was recognized for its exceptional capacity in robotics, autonomous systems, and AI, with particular strengths in facial recognition technologies (Ding, 2018). The Chinese model of AI development is underpinned by the implementation of 'safe city initiatives' (Artigas, 2017), a result of the growing use of facial recognition technologies to monitor and manage citizens in the urban public realm through a combination of CCTV and advanced AI. Building on these systems, the state, cities, and corporate partners readily repurposed existing AI and robotic applications to meet the demand of COVID-19 containment. China's response is 'perhaps the most ambitious, agile and aggressive disease containment effort in history', drawing on a range of technological, digital, and social control strategies (WHO, 2020: 16). Our interest is in four sets of robotic and AI-enabled pandemic management applications.

### *Replacing humans in service delivery*

Private sector firms have been undertaking testing of ground and aerial robotics primarily for goods delivery, yet this is restricted in most countries including China by practical challenges in negotiating complex urban environments, regulatory limits, and high costs. COVID-19 has given China's leading e-commerce and delivery firms (particularly JD.com and Meituan-Dianping) a mandate for autonomous deliveries to hospitals and residential compounds on

public roads (Synced, 2020). COVID-19 has also sparked expansion of drone use for medical transport and commercial freight deliveries, especially in quarantined areas, where previously drone use had been prohibited (Yang and Reuter, 2020). Yet, in spite of the enhanced role of robotics in pandemic logistics, its impacts have been minimal in terms of the number of parcels delivered. For instance, the most talked-about JD.com robot serving a Wuhan hospital ran a pre-designed straight route of merely 600 meters, delivering up to 15 parcels per day. These 'last-mile' autonomous deliveries during the COVID-19 pandemic are largely promotional demonstration projects as the infrastructure is not yet in place to allow for more extensive autonomous operations and the upfront costs remain prohibitive.

## *Urban biometric surveillance*

By 2019, major Chinese cities had a sophisticated infrastructure for enhanced movement control in the public realm via security cameras linked to facial recognition. The processing of millions of Chinese citizens' data is facilitated by extended AI capability, justified on the grounds of public safety and the efficient management of dense urban populations. COVID-19 has led to a process of repurposing the existing camera surveillance system by pairing CCTV, facial recognition technologies, and thermal imaging for biometric screening to identify citizens with high temperatures. Pandemic control via temperature sensing has arguably been a crude diagnosis, reminiscent of the problems with using airport detectors to identify SARS in 2003. However, in a context where any potential symptoms are treated with caution and control, the fusing of facial recognition and heat-sensing is a significant extension of biocontrol that prefigures a much wider sphere of future biometric surveillance.

## *Digital movement control*

The reopening of the city of Wuhan marked China's strategic shift to selectively resuming urban circulation nationwide. China put in place a responsive colored QR code program as an automated filter to control physical mobility. Using smartphones to scan a barcode triggers users' health code apps (via Alipay or WeChat), displaying users' color-coded ranking. Only green code holders can obtain a 24-hour permit to access urban spaces. A red code requires supervised isolation, with domestic quarantine for a yellow code. According to the state-run Xinhua news agency (2020), the colored-rating algorithm is based on integrated data from the national identity number, home address, self-reported health status, personal travel history, and relationship to infected or suspected cases. However, users have suggested that there are multiple instances of false negatives and positives reported in this system. The data on which the codes draw is also dispersed and geographically fragmented so that the app does not necessarily function accurately if a user moves to a different city. However, the system gives the state enormous power to control social movement at a distance and without contact-based policing.

## *Robotic clinical care*

Social robotics is set to transform healthcare in various domains, including new infrastructures of augmented and assisted living. With aging populations, healthcare is a significant area of urban robotics, albeit not always an area that is seen as part of urban politics. Equally, research on healthcare robotics had paid limited attention to the issue of pandemic control. The exposure of healthcare workers to COVID-19 and their need to self-isolate has been a major concern, especially given the significant demands on intensive care. In China, AI-powered CT scanning of the lungs was a primary method for early diagnosis of COVID-19, reducing the time spent on diagnosing a case from 30 minutes to seconds. New applications included the clinical trial of a remote-controlled robot to collect throat swabs for testing. In the city of Hangzhou, doctors teleoperated a 5G-powered robot to conduct an ultrasound examination and diagnosis on a patient 700 km away in Wuhan. The growing adoption of AI and robotics in hospitals has arguably provided additional capacity for the extremely stretched health service despite concerns about their accuracy and data security.

## Conclusion

The field of urban studies has made important contributions to the study of SARS and other infectious diseases by exploring the conceptual linkages between global cities and epidemiology (Ali and Keil, 2006). This commentary adds another dimension to that work by highlighting linkages between urban pandemic management and the emerging field of urban robotics. Urban robotic restructuring has the potential to transform the infrastructures of everyday social life through technologies of human augmentation and replacement. Prior to COVID-19, these technologies were developing rapidly but the pandemic has accelerated real-world experimentation, and these demonstrations have extended the possibility for their wider application. Urban robotics has had particular appeal during the COVID-19 pandemic because it assists with service delivery, policing, and healthcare while minimizing human-to-human contact.

So far these technologies have been framed as largely socially beneficial, with profiling and intervention based primarily on a logic of pandemic control. It might also be argued that much of the robotic response to COVID-19 has been confined to initiatives that are well-promoted but relatively limited in functional capacity. However, what the Chinese experience points to is the potential for an extended reach of AI and automation into everyday lives facilitated by autonomous systems, not least in relation to overlapping forms of biosecurity control and spatial management. As we have argued elsewhere, the application of automated urban management is moving much more quickly than public and political debate (While et al., 2020). There are undoubtedly economic, social, and health benefits of urban robotics, but these beneficial uses should not override the need for meaningful public scrutiny of their application in different urban contexts. Critical urban research can help ensure that the accelerated technological response to pandemic control does not reinforce or extend the proprietorial logic of the smart city.

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