HIGH-TECH CONTROL IN THE SHANGHAI LOCKDOWN

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Executive Summary

1. Some of the earliest uses of robots in pandemic Shanghai were in the form of disinfection robots that can scan UV rays into a room to eliminate germs.

2. Shanghai residents' singing resistance from their balconies against the lockdown was stopped by drones equipped with speakers that commanded them to desist singing and control their "thirst for freedom" to battle China's most serious COVID-19 coronavirus outbreak since Wuhan.

3. While the drones were patrolling in the air, robotic patrol dogs roamed the streets. Some netizens and social media users captured moving images of robotic dogs with loudspeakers walking through lifeless streets to announce public messages.

4. The use of drones and robotic dogs to discourage Shanghai residents from moving out of their residences provided a glimpse of the country's future, its social control system and signalled the arrival of the age of co-existence with machines.

5. Social media bots reached all household with public health messages. Weibo (China's equivalence to Twitter) announced public safety messages to college students on mask wearing and staying in their dorms.

6. Unlike foreign accounts which tended to cast drone operations in Shanghai as a symbol of future dystopia, Chinese media conceptualised drones differently. Some saw drones as rescuers in the lockdown situation.

7. Robots and drones were not totally for social control. Shanghai firepersons utilised drones to carry out no-human contact dissemination of foodstuffs and daily products, alleviating dependence on overstretched delivery riders and drivers (which previously resulted in food shortages).

8. Even donations provided by other provinces were despatched to Shanghai by drones. East China Unmanned Aerial Vehicle Base in Jinshan Industrial Zone despatched

two drones delivering 20 kgs of rice and vegetables donated by Hebei province from a distribution warehouse in Shanghai's Jinshan district to Baowei village.

9. Rolling drones which require human-drone collaboration to operationalise were also featured in the Shanghai lockdown. Health workers and pandemic mitigation officials dressed in personal protective equipment were still needed to load the food items onto rolling drones which can carry 3-4 times as much weight as a human delivery driver.

10. Meanwhile, China's determination to keep robot production going was visible even during the Shanghai COVID-19 lockdown. One of China's largest robot manufacturers Siasun had its 91 workers quarantined at its Shanghai plant during the lockdown to keep output going and meet production schedules in what has been described locally as a "closed-loop" system.

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LIM Tai Wei*

The Rise of Machines

1.1 The Shanghai lockdown from March to April 2022 drew the attention of world media on its supply situation and the use of advanced Industry 4.0 technologies in mitigation measures. While robots and drones were used in the lockdown, some of the earliest use of robots in pandemic-era Shanghai were in the form of disinfection robots that can scan UV rays into a room to eliminate germs.

1.2 Deputy dean of Shenzhen University General Hospital Gong Peng noted: "Compared to the robots you see in manufacturing plants, these seemed like gimmicks with nothing unique about them. [Before the robots were introduced] every time a nurse wanted to deliver food to a patient, he or she had to wear a protective suit that would take ten minutes to put on. That was when protective gear supplies were really tight, so the robots helped us a lot".[1]

1.3 In Shanghai and other parts of China, private sector firms donated disinfectant and food delivery robots to the hospitals to mitigate the virus spread and handle logistics; with such demands, makers have decided to ramp up their production since 2020. For instance, Shanghai's Keenon Robotics which retails food-serving robots to large chain restaurants like Haidilao not only increased its production but also constructed medical bots.[2] Keenon Robotics' Chief Executive Officer (CEO) Li Tong revealed: "We had been planning this for the past year, but the virus has caused us to speed

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1 Horowitz, Josh, "Robots rising: Coronavirus drives up demand for non-human labour in China" dated 20 March 2022 in Reuters [downloaded on 20 March 2022], available at https://www.reuters.com/article/health-coronavirus-china-robots-idCNL4N2AY1SE.

2 Ibid.

things up".[3] Chinese companies were not the only ones meeting the sudden rise in demand for robotic systems. Denmark's UVD Robotics which manufactures UV disinfection robots also revealed a distribution agreement with a Chinese medical device supplier in 2020 to implement their robotic technologies throughout China.[4]

Regulation Enforcement

2.1 Smart technologies and products were also deployed in Shanghai's battle against the recent COVID-19 surge. When senior China correspondent for *The Economist*, Alice Su, distributed a Weibo (the major Chinese blogging website) video with the caption: "Shanghai residents go to their balconies to sing and protest the lack of supplies", she may not have expected a response from the machines to these activities.[5] Chinese drones flying through the city were broadcasting COVID-19 regulations like mask-wearing, social distancing and telling Shanghai residents to "control your soul's desire for freedom" and remain inside their compounds.[6] This prompted some netizens to yell that they were asking for assistance due to mandatory prolonged lockdown and food shortages that could not be resolved by unmet online orders.[7]

2.2 Netizens who came into contact with these machines and recorded their presence warned others of drones with red blinking lights outside housing blocks and broadcasting loud messages for Shanghai residents to simmer down their public airing of grievances.[8]

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3 Ibid.

4 Ibid.

5 Teh, Cheryl, "Shanghai is flying drones over districts to tell citizens under lockdown to 'curb your soul's desire for freedom' and comply with COVID-19 restrictions" dated 7 April 2022 [downloaded on 7 April 2022], available at https://www.insider.com/shanghai-deploys-drones-robot-dogs-broadcast-covid-19-lockdown-guidelines-2022-4.

6 Ibid.

7 Ibid.

8 Ibid.

2.3 While the drones were patrolling in the air, robotic patrol dogs were roaming the streets. Some netizens and social media users captured moving images of robotic dogs walking through lifeless streets (some with loudspeakers to announce public messages).[9] Adding these robotic dogs to images of drones flying in the sky, netizens captioned them as "a glimpse of Cyberpunk 2077" based on a dystopian video game that many Chinese gamers play.[10]

2.4 The patrol dogs served propaganda work (or 'publicity work' according to Chinese state-owned news agency *Xinhua*[11]) and public awareness campaign needs. The authorities were keen to show off the latest technologies used in social enforcement. China's state-owned media *The Paper* showed a robotic dog armed with a loudspeaker blaring: "Wear the mask, wash your hands frequently, check your temperature".[12] The use of drones and robotic dogs to discourage Shanghai residents from leaving their residences provided a glimpse of the country's future and its social control system, and signalled that the age of co-existence with machines has truly arrived.[13]

Suasion Campaigns and Preventive Measures

3.1 Social media bots reached all households with public health messages. Weibo (China's approximate counterpart to Twitter) announced public safety messages to college students, telling them to wear masks and stay inside their dorms: "Disinfect regularly. Ventilate your home. Prevent the pandemic in a scientific manner".[14] Some of these contraptions were deployed by the local uniformed forces. Huangpu

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9 Ibid.

10 Ibid.

11 Xinhua Global Service and Huaxia (Editor), "Shanghai builds drone network for publicity, delivery amid COVID-19 resurgence" dated 2 April 2022 in GLOBALink [downloaded on 2 April 2022], available at https://english.news.cn/20220402/39d00e79490e4c299b29294983620039/c.html.

12 Nicholson, Kate, "Apparently Drones And Robot Dogs Are Issuing Lockdown Commands In Shanghai" dated 6 April 2022 in Huffington Post [downloaded on 6 April 2022], available at https://www.huffingtonpost.co.uk/entry/covid-lockdown-drones-china-shanghai_uk_624d8a70e4b09817450875e2.

13 Ibid.

14 Teh, Cheryl, "Shanghai is flying drones over districts to tell citizens under lockdown to 'curb your soul's desire for freedom' and comply with COVID-19 restrictions".

district police (*gongan*) utilised drones with a loudspeaker system to patrol key areas and update residents on pandemic-mitigation and control policies.[15]

3.2 In the preventive measures arena, Shanghai newspaper *Xinmin Evening News* revealed that China utilised drones to disinfect public areas wherever COVID-19 coronavirus cases were detected.[16] One of the most common drone models in use, the SF Fangzhou X8 UAVs have a maximum takeoff weight of 42 kg and are able to deliver 10 kg of items for a maximum distance of 20 km.[17] Chinese journalist Li Qian observed how the SF Fangzhou X8 drone has been utilised to deliver necessities and operationalise disinfection campaigns across districts in Shanghai like Jinshan that faced a shortfall in volunteers.[18] These drones allow medical officials to lessen human contact with the assistance of professional drone operator like Xue Bin from the East China UAV Base (home to the SF Fangzhou X8 drones) overseeing more than 30 drones in such operations.[19]

3.3 Xue Bin, the base manager, articulated: "We have started to deliver supplies including medicines and lunch packs since the outbreak of this round of epidemic. Now we also use them to transport food, such as rice, vegetables and meat. They are mainly used for distribution in the city, but they can also deliver first-aid items. This way greatly improves the effectiveness of emergency distribution as it's not affected by traffic conditions, while it can also reduce the infection risk during delivery…The base has given full play to its advantages by delivering emergency supplies, disinfecting public areas, and maintaining public safety and order since entering closed-loop management, which reduces the risk of contact and alleviates the

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15 *Xinhua*, "Smart technologies aid Shangha's fight against COVID-19 resurgence" dated 6 April 2022 in The State Council The People's Republic of China [downloaded on 6 April 2022], available at http://english.www.gov.cn/news/videos/202204/06/content_WS624cf201c6d02e5335328cf2.html.

16 Nicholson, Kate, "Apparently Drones And Robot Dogs Are Issuing Lockdown Commands In Shanghai".

17 He, Qi, "Unmanned aerial vehicles used to bolster supply of food, medicine" dated 8 April 2022 in China Daily [downloaded on 8 April 2022], available at https://www.chinadaily.com.cn/a/202204/08/WS624f9785a310fd2b29e55c3a.html.

18 Li, Qian, "Drones come to the rescue in suburban Shanghai district" dated 6 April 2022 in Shine [downloaded 6 April 2022], available at https://www.shine.cn/news/metro/2204064041/.

19 Ibid.

shortage of volunteers".[20] Spanning 2.73 square km in size, East China UAV Base was a pioneering civil UAV experimental base in China. It was established in 2018 to operate more than 50 UAV models for logistics and disinfection activities.[21] Drones from the East China UAV Base have been providing medical supplies to Shanghai's Jinshan district since 5 April 2022.[22]

3.4 Some Western tech media outlets noted that the Chinese state media had been touting the utilisation of robots to facilitate the "temporary closed-off management" of Shanghai under the zero-COVID policy/political worldview and the boosting of 47,000 temporary hospital beds and four million tests daily (compulsory for all residents).[23] Unlike foreign accounts which tended to cast drone operations in Shanghai as a symbol of future dystopia, Chinese media conceptualised drones differently. Some saw drones not as dystopia but as rescuers in the lockdown situation. Journalist Li Qian wrote how drones came "to the rescue in suburban Shanghai district" as "workers prepare a drone to deliver necessities to people in need". A fleet of more than 30 drones has been delivering goods for over more than 500 hours of flight time.[24]

3.5 Li also reported how an unmanned autonomous flying fleet took over the task of disseminating daily goods to needy residents without human contact in Shanghai's Jinshan district.[25] On 5 April 2022, approximately 1,200 antigen test kits were transferred from the East China UAV Base for SF Fangzhou X8 drones to a centralised quarantine site within 20 minutes while providing individual residents with medicines.[26] Much earlier, Zhuanqiao town residents in Shanghai's Minhang

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20 Ibid.

21 Ibid.

22 Ibid.

23 Sharwood, Simon, "China rolls out bots to enforce 'temporary closed-off management' of Shanghai" dated 6 April 2022 [downloaded on 6 April 2022], available at https://www.theregister.com/2022/04/06/shanghai_lockdown_robots/.

24 Li, Qian, "Drones come to the rescue in suburban Shanghai district".

25 Ibid.

26 Ibid.

district utilised drones to disseminate information on the availability of free nucleic acid tests (saving manpower in the process).[27]

3.6 The Chinese media published individual testimonies of people saved by the drone operations. For example, Luo Xirong (chairperson of the Real Time Printing Company) revealed that his director of manufacturing and printing factory production supervisor[28] Ji Ruwang fell ill at noontime on 5 April 2022 after continuous overtime work. Ji caught a mere four hours of winks per night without taking his blood-pressure medication that was in shortage during the Shanghai lockdown.[29] Ji was said to be on overtime shifts preparing makeshift beds for the company and manufacturing epidemic mitigation supplies for the customers.[30]

3.7 Ji's condition was immediately conveyed by Luo to lockdown officials at the service centre of the industrial park where the company is located: "It's so convenient that my employee got his medicine 30 minutes after I requested a delivery".[31] Ji himself remarked that he now has enough medicine to last a month.[32]

Resource Allocation Functions

4.1 Not all functions related to robots and drones were about social control. Shanghai firepersons utilised drones to carry out no-human contact dissemination of foodstuffs and daily products and this was a relief to overstretched delivery riders and drivers (which previously resulted in food shortages).[33] The human-friendly assistive drones ferried medicines to residents who were unable to go to the clinic

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27 He, Qi, "Unmanned aerial vehicles used to bolster supply of food, medicine".

28 Ibid.

29 Li, Qian, "Drones come to the rescue in suburban Shanghai district".

30 He, Qi, "Unmanned aerial vehicles used to bolster supply of food, medicine".

31 Li, Qian, "Drones come to the rescue in suburban Shanghai district".

32 He, Qi, "Unmanned aerial vehicles used to bolster supply of food, medicine".

33 Parkhill, Maggie, "Amid strict lockdown, Shanghai firefighters deliver necessities via drone" dated 13 April 2022 in CTVNews.ca/The Associated Press/CNN [downloaded on 13 April 2022], available at https://www.ctvnews.ca/health/coronavirus/amid-strict-lockdown-shanghai-firefighters-deliver-necessities-via-drone-1.5859753.

under lockdown.[34] The Xuhui district fire department was a major drone operator for carrying out pharmaceutical drugs deliveries to the areas around its vicinity.[35]

4.2 The Shanghai fire department publicly released videos of their firefighters decked out in firefighting gear while remote controlling a drone to deliver orange-marked packs of daily necessities to windows of residential blocks.[36] Like the Shanghai firefighters, the law enforcement agencies were also issued drones. Huangpu district police (*gongan*) utilised drones armed with loudspeakers to monitor crucial areas of the city while sharing the authorities' information and updates on pandemic mitigation, prevention and control measures and policies to the local residents.[37]

4.3 Government uniformed forces were not the only ones utilising drone technologies. Some Chinese multinational companies have seen the potential of drone deliveries during the lockdown. Delivery conglomerate SF Express utilised drones to disseminate medicine and virus mitigation materials to Shanghai residents under lockdown (e.g. seven such drones operated in Anting town in Shanghai's Jiading district), with each drone delivering up to 10 kg of materials operating at 14 metres per second for a total duration of 30-40 minutes.[38] Even donations provided by other provinces were ferried into Shanghai by drones. East China Unmanned Aerial Vehicle Base in Jinshan Industrial Zone despatched two drones delivering 20 kgs of rice and vegetables donated by Hebei province from a distribution warehouse in Shanghai's Jinshan district to Baowei village (three kilometres away with only five minutes of flight time) on 7 April 2022 before Baowei volunteers disinfected the supplies for distribution to villagers.[39]

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34 Sharwood, Simon, "China rolls out bots to enforce 'temporary closed-off management' of Shanghai".

35 Xinhua Global Service and Huaxia (Editor), "Shanghai builds drone network for publicity, delivery amid COVID-19 resurgence".

36 Parkhill, Maggie, "Amid strict lockdown, Shanghai firefighters deliver necessities via drone".

37 *Xinhua*, "Smart technologies aid Shanghai's fight against COVID-19 resurgence" dated 6 April 2022 in The State Council The People's Republic of China [downloaded on 6 April 2022], available at http://english.www.gov.cn/news/videos/202204/06/content_WS624cf201c6d02e5335328cf2.html.

38 *Xinhua*, "Drones help deliver medicine, anti-virus supplies to Shanghai residents" dated 18 April 2022 in GlobalLink [downloaded on 18 April 2022], available at https://english.news.cn/20220418/ef81dc3648cb43a683d277012635088b/c.html.

39 He, Qi, "Unmanned aerial vehicles used to bolster supply of food, medicine".

4.4 Besides flying drones, rolling drones were also featured in a major way in the Shanghai lockdown. Rolling drones are machines that are still not fully autonomous as there remains a need for human-drone collaboration to operationalise their use. Health workers and pandemic mitigation officials dressed in personal protective equipment were still needed to load the food items onto rolling drones which can carry 3-4 times as much weight as a human delivery driver.[40]

4.5 Rolling drones were also used to disinfect hospital grounds; an initial team of 28 rolling robots disinfected the aisles of Shanghai's makeshift hospitals in the converted convention halls.[41] The first area for the deployment of these 28-robots teams was in the Shanghai New International Expo Centre in the Pudong New Area designated as the city's biggest makeshift quarantine zone.[42] Meanwhile, in Anting New Town in Jiading district, fully autonomous vehicles (AVs) that were able to carry the load of three to four human deliverers were deployed for logistical purposes in transporting fresh fruits and vegetables to local communities in that area.[43]

4.6 The discrepancy between the efficacy of Industry 3.0 and 4.0 technologies was noted by some observers in the international media. While Industry 4.0 robots and drones were deployed during the Shanghai lockdown and maintained supply chains formerly handled by humans, many Industry 3.0 mechanical machines like industrial robots were laying quiet in Shanghai's factories,[44] potentially contributing to more supply chain disruptions.

4.7 This could be an indication of the direction for the next stage of Shanghai's industrialisation: upgrade Industry 3.0 industrial robots to those of Industry 4.0 used by emergency services during the lockdown. As it is a major industrial hub for

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40 Sharwood, Simon, "China rolls out bots to enforce 'temporary closed-off management' of Shanghai".

41 Ibid.

42 *Xinhua*, "Smart technologies aid Shanghai's fight against COVID-19 resurgence".

43 Ibid.

44 Sharwood, Simon, "China rolls out bots to enforce 'temporary closed-off management' of Shanghai".

producing auto vehicles and other products and the world's busiest port,[45] both can benefit from more Industry 4.0 tech implementation. This upgrade has already started in other Chinese business sectors like logistics and service sectors. For example, Alibaba celebrated with fanfare its millionth delivery by rolling out its bots and has announced plans to greatly boost the size of its robotic fleet, along with other Chinese e-commerce and delivery firms.[46]

4.8 Meanwhile, even as the use of drones and robots expands, China's determination to keep robot production going was visible even during the Shanghai COVID-19 lockdown. One of China's largest robot manufacturers Siasun had its 91 workers quarantined at its Shanghai plant during the lockdown to keep output going and meet production schedules in what has been described locally as a "closed-loop" system.[47] Chinese state-owned media *Shanghai Observer* and other global outlets reported this development on 4 April 2022, publishing photo images of production workers taking naps on cardboard materials in their conference room and staff recreation facilities at their south-eastern Shanghai factory.[48]

4.9 Siasun Vice President Lu Shangwu and the company's management kept production going immediately after the Shanghai municipal government announced the lockdown on 27 March 2022.[49] Their sense of responsibility was especially acute given the importance of Siasun as one of China's biggest robot manufacturers with a market valuation of approximately 14.1 billion yuan (US$2.2 billion) in April 2022.[50] Against the backdrop of a strong demand for robotic systems produced by the factory, Siasun had the important task of maintaining robot supplies for the country's manufacturing production lines. Lu and his team have to keep Siasun

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45 Ibid.

46 Ibid.

47 Soon, Weilun, "Dozens of workers were made to stay at a Shanghai robotics plant and sleep on cardboard amid the city's Covid lockdown" dated 6 April 2022 in Yahoo Finance and Business Insider [downloaded on 6 April 2022], available at https://finance.yahoo.com/news/dozens-workers-were-made-stay-082012395.html.

48 Ibid.

49 Ibid.

50 Ibid.

going in the lockdown to avoid "a cascading effect" of supply chain disruptions down the manufacturing lines, including committed deliveries to both local and overseas clients such as those in Mexico and Zhangjiagang (China).[51]

4.10 The pandemic-era demand for service robots in China was a result of a lack of manpower and social distancing requirements, which greatly enhanced the formerly modest growth of the industry. Since 2020, Chinese venture capitalists specialising in robotics have projected increases in demand for robots in China, something that took off in late January 2020 when the virus started to spread like wildfire in the country.[52] The boost in demand was due to the need for service robots delivering food and drinks from eateries to hospitality establishments and the People's Liberation Army (PLA) in ensuring operational continuity to manage infections in their hospitals while observing social distancing.[53] Foreign robot manufacturing companies also trained their sights on this trend in China. Emil Jensen, vice president of China sales for Denmark's Mobile Industrial Robots that manufactures robots tailored for hospitals and factory conditions and needs, articulated: "The healthcare segment has been really hot. We are seeing a many, many-fold increase in new demand from hospitals, and a lot of people are calling us for the first time".[54]

4.11 The demand for robots has also caught the attention of investors. Yu Chen, managing director of venture capital Yunqi Capital, noted that Beijing's Yunji Robotics (delivery bots maker) and Shanghai's TMIRob (disinfection robots manufacturer) have both increased production during the pandemic and Yu estimated that Chinese firms have retailed approximately 15,000 service robots from 2018 to 2020.[55] The pandemic has also stimulated demand for industrial automation technologies, a lesson that was well-learned in Wuhan's semiconductor foundries

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51 Ibid.

52 Horowitz, Josh, "Robots rising: Coronavirus drives up demand for non-human labour in China" dated 20 March 2022 in Reuters [downloaded on 20 March 2022], available at https://www.reuters.com/article/health-coronavirus-china-robots-idCNL4N2AY1SE.

53 Ibid.

54 Ibid.

55 Ibid.

when they were able to keep production going during the pandemic because of their advanced levels of smart automation implementation and processes.[56]

4.12 The major challenge to overcome in the use of robotics and automation is the economic impact of COVID-19 on many firms which affected their automation budgets and prevented them from drawing out millions of dollars to spend on smart technology systems.[57] This could have a ripple effect in the near future since it typically takes 6-12 months for complete implementation of systems.[58] Huan Liu of Mujin explained: "For new customers, it depends on which factor is stronger. The need to replace labour during the virus, or the need to balance the budget as sales go down during the virus".[59]

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56 Ibid.

57 Ibid.

58 Ibid.

59 Ibid.