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Robotics & COVID-19: How Robotic Technologies are Critical in Getting America Up and Running in The Age of the COVID-19 Pandemic

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INTRODUCTION

The Coronavirus (COVID-19) pandemic has changed daily life around the world, affecting everything from how we do business and procure necessities, to how we care for the sick and vulnerable. With public health now top-of-mind, COVID-19 is causing us to rethink the safety protocols of everyday processes like cleaning and disinfecting public spaces, and how to manufacture critical equipment in times of crisis and beyond. With all of this, roboticists are rising to the occasion, implementing existing technologies in areas of need[1] and working to develop and perfect technologies that ensure safety while mitigating disruption to lives and livelihoods. Robotic systems are crucial to the nation's resiliency now, as we face the challenges of a multi-wave pandemic, and are a key tool as we consider and plan for potential future global crises.

The federal government has an important role to play in preparing and equipping society to be able to anticipate and formulate responses, and not just react, to global threats like COVID-19. Robots and robotic technologies can play a critical role in pandemic response (as seen with COVID-19), but also in facilitating a society that is less susceptible to contagious diseases in general. Robots can and should play a major role as we work to create a world that is able to address potential threats and lessen their impact before they even happen. The United States needs to be a leader in this effort to ensure not only the safety and security of the American people and the American economy, but also to ensure our technological independence and workforce agility— both critical elements in the nation's ability to rapidly develop and deploy technologies in times of crisis.

As the world pays increased attention to public health, health care, and cleanliness, robotic innovations will certainly play a vital role in creating a more secure future. Robotic technologies can create safer work environments and respond to potential supply-chain disruptions, thereby ensuring that American workers are best prepared to function in times of crisis. Below we consider five examples of how we can, and in some cases already do, use robots to combat COVID-19 and prepare for what comes next:

1. Deep Cleaning
2. Rapid Manufacturing
3. Logistics
4. Healthcare
5. Telepresence

[1] http://roboticsforinfectiousdiseases.org/how-robots-are-being-used.html

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1. Deep Cleaning

Robots are being used for routine deep cleaning and sanitation all around us.[2] We have robots cleaning floors in both households and in industrial settings, and mobile robots carry ultraviolet (UV) lamps and hydrogen peroxide vapor (HPV) in hospitals, health centers, government buildings, and public centers across the globe to disinfect surfaces.[3] Now, in the wake of COVID-19, airlines, food banks, dormitories, and gathering venues have sought these technologies in hopes of cleaning surfaces that may contain viruses without risking human contamination. As researchers are developing next-generation UV lamps, foggers, and sprays that can be used for disinfecting, there also comes an increased need to invest in robotic manipulation technologies to make these innovations fully effective.

Improving robotic applications such as deep cleaning requires ongoing basic research in sensing and manipulation. Right now, we can use existing technology to partially disinfect surfaces before human workers are exposed. Hospitals caring for COVID-19 patients are already using existing robotic technology to disinfect contaminated areas, lessening the risk of infection for the critical medical workers.[4] However, current technology for disinfection has some limitations. For instance, sanitizing UV light cannot bend around surfaces to reach the backside of doorknobs. More research and targeted investment in robotic manipulation technologies is needed so that we can realize the full potential of these fundamental technologies and apply them to emergent hygiene protocols that can better our ability to perform deep cleaning safely and efficiently.

2. Rapid Manufacturing

Robotics and automation are a mainstay of advanced manufacturing in the United States. The Department of Defense recognized this in specifying Advanced Robotics as a topic for one of its eight Manufacturing USA institutes aimed at strengthening the U.S. industrial base. While robots are vital to advanced manufacturing, we have not yet achieved the full potential of rapidly reconfigurable robotic manufacturing, that is, manufacturing robots that are able to quickly retool and adapt their capabilities.

With COVID-19, we are now seeing industries everywhere adapt to help combat the pandemic. General Motors, Tesla, and Ford, for example, are making

[2] https://viterbischool.usc.edu/news/2020/04/robotic-arms-extend-the-reach-of-uv-disinfection/
[3] http://emag.directindustry.com/disinfection-robots-against-covid-19/
[4] https://www.forbes.com/sites/richblake1/2020/04/17/in-covid-19-fight-robots-report-for-disinfection-duty/#66cf93172ada

ventilators instead of cars, and 3M and Honeywell are working to meet the enormous surge in demand for PPE and refine their emergency response. As companies work to transform their capabilities, they are uncovering unforeseen hurdles that hinder manufacturing flexibility. In some cases, it is the technology that is impeding flexibility. We are seeing a focus on quick, point solutions that quickly address one particular problem without considering how the fix will affect overall system agility. Instead, there must be a transition to understanding the complexities of production agility, including the nimbleness of the equipment and the personnel who run it. We need to begin pursuing production agility so that American industry can carry out a quicker pivot to a coordinated response to potential future disruptions from pandemic waves.

In addition to adapting to different manufacturing needs, robots help increase human safety in manufacturing facilities. Traditionally, safety in manufacturing meant using robots to perform dangerous jobs such as unloading hot pieces from a forge, welding, heavy lifting, and performing tasks in toxic environments or that can cause repetitive strain injuries. But more recently in the wake of COVID-19, we see how simple solutions can have a dramatic impact on the safety of employees. Robots can be used as a tool to create distance while still maintaining and even improving overall productivity. For instance, robot assistance in meatpacking could increase social distancing of workers in the facility, while also improving resilience, by allowing workers to maintain their productivity and plants to continue operating even as some workers self-quarantine.

In addition to using robots to make changes to production agility and manufacturing facilities themselves, robots can also be used to rapidly manufacture vital supplies such as tests for the COVID-19 virus and its antibodies. There is huge potential in using robots in making, handling, and distributing vital viral tests in pharmaceuticals, and robotics technology will be essential for the rapid production of the many millions of viral tests and doses of potential vaccines that we will require in the coming months.

3. Logistics

Modern warehouses and distribution centers already have robots picking, packing, and shipping orders. We are even beginning to see delivery robots, in the form of airborne drones and surface robots, providing the “last mile” of delivery. However, technical challenges remain to ensure the viability of the supply chain in times of crisis. Consider this: From the time an e-commerce order is selected to leave a warehouse it is touched by human hands an average of 22 times before it arrives at its destination, representing 22 chances for contamination and for spreading the virus. Considering COVID-19, where deliveries have become mission-critical, this presents a major challenge, but

also an opportunity to use robotic technology to create a safer environment for workers all along the logistics chain.

The "last mile" problem presents a unique set of challenges that roboticists are working to solve. Mobile robots are only now starting to be used to deliver packages to their final destinations,[5] that is, specific houses, buildings, or apartments. The federal government can help usher in these positive changes through careful policy considerations that build a framework to measure success and usher in the technology. However, the federal government must be thoughtful in its interceding as to not limit technological advancement.

4. Healthcare

Robots can perform dangerous and repetitive work in the healthcare field that humans should not be put at risk doing, such as handling hazardous materials, processing viral antibody tests,[6] and handling contaminated throat swabs. Robotic technologies should be normalized in the healthcare industry in order to best protect medical workers and patients. Not only should robotic technology be used more regularly in medical settings under normal circumstances, but specific thought and planning should be given to how robots can be deployed quickly to respond to pandemic-like situations to protect the vulnerable.

Soft robotics—that is, robots built from materials that mimic living tissues and that have mechanical properties that can perform gentle, human-like movements—offer a powerful tool to help medical professionals deliver effective, efficient treatments to patients with minimal risk of contagion. The technology still faces considerable engineering challenges before it is readily available, but that makes it even more crucial to invest in developing today. There are certain procedures, such as intubation, that pose a high risk of infection for caregivers, and for which soft robotics can provide a solution that significantly reduces the risk to caregivers and patients. Soft robotics technology can also aid medical staff with assistive tasks such as moving patients and minimizing the risk of contagion between caregivers and patients. Robotic solutions can also contribute to patient-centric challenges such as touchless monitoring of vital signs and providing automatic support for ventilation. This would help free doctors, nurses, and other medical staff from the constant risk of infection, allowing them to instead focus on delivering the best possible care to their patients during pandemics.

[5] https://techcrunch.com/2020/04/09/starship-technologies-is-sending-its-autonomous-robots-to-more-cities-as-demand-for-contactless-delivery-rises/?renderMode=ie11
[6] http://med.stanford.edu/news/all-news/2020/04/stanford-medicine-develops-antibody-test-for-coronavirus.html

5. *Telepresence*

With COVID-19, we are seeing telepresence take on an even larger role in society, connecting humans for all kinds of reasons. Robots can help to make a remote user feel "there," whether "there" is visiting a loved one in a nursing home, attending school remotely,[7] viewing a sporting event, or monitoring operations in a factory. Furthermore, in a time when physical distancing is necessary to ensure safety, businesses are adapting by moving services and functions online to best protect their employees and customers. Virtual reality and robotic controls are becoming normalized as companies adapt to be able to conduct gatherings and simulations such as large conferences safely and effectively.

But while innovative technology can help to make telepresence more viable in situations where face-to-face contact is not an option, such as educational opportunities or specialized medical treatments that are unavailable to geographically isolated communities, one lesson of the COVID-19 pandemic is that remote meetings, classes, or presentations cannot completely substitute for their in-person, live counterparts. Telepresence technology has the potential to keep people engaged while they practice social distancing, but it can also be used to make physical nearness safer as well. For instance, with more research and investment, proximity awareness sensing in the form of a wearable technology could be used to discern a potential infected area or contact surfaces that should be avoided. This can then be combined with wearable robotic and haptic feedback devices that alert the user of such dangers, which would allow for far less societal disruption than we have seen with COVID-19.

[7] http://www.vgocom.com/housebound-girl-incurable-condition-experiences-school-thanks-robot-called-%E2%80%98princess%E2%80%99-goes-class-her

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Summary

Robotic technologies being used to help curb and respond to the COVID-19 pandemic have proven critical during this contemporary global health crises, but COVID-19 will certainly not be the last such challenge the world will face. As such, the federal government should act now to stimulate and coordinate the development of robotic technology that will allow the United States to best respond in future pandemics while also reducing their likelihood. The world is investing in innovative robotic technologies and competition in the robotics space remains fierce. When the next challenge arises, will the United States be prepared and agile enough to respond? We must see the current COVID-19 pandemic as a call to action to do what we can now to prepare for the future. Therefore, we must:

1. Use current robotics technologies to help where possible now, such as with deep cleaning, rapid manufacturing, logistics, healthcare, and telepresence.
2. Further improve ongoing basic research in sensing, manipulation, and actuators.
3. Accelerate investments in fundamental robotics research because we do not know what the next crisis will be, but we know there will be one.

When COVID-19 first broke out, China limited its exports of critical equipment like ventilators, leaving the U.S. to scramble as it worked to adapt existing supply chains to fill in the gaps. The U.S. does not want to find itself dependent on other nations for critical needs in times of crisis. America has traditionally been the home of advanced innovations, and to keep a competitive edge we need to invest in both deploying technology readily available today, and encouraging further growth in innovative technology. Sustained support for robotic research and development will help us create these technologies and help us prepare the scientific basis for the responses to the next, unknown, pandemic-like event.

This statement represents the views of the Robotics Public Policy Task Force of the ASME Committee on Government Relations and not necessarily the views of ASME as a whole.