

Mobile Robots Application Against Covid-19 Pandemic

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Abstract—This article presents an investigation about the different applications of mobile robots in the fight against the Covid-19 pandemic. It shows the different contributions of companies around the world that seek to adapt to the new needs in order to be able to mitigate the progress of the Covid-19 using mobile robots as a tool, focusing primarily in the area of health and service.

Keywords—COVID-19, Industrial Robot, Mobile Robotics, Pandemic, Service Robot

I. INTRODUCTION

The COVID-19 is an infectious disease caused by the recently discovered coronavirus. This virus it spreads mainly through droplets of saliva or runny nose when an infected person coughs or sneezes, turning it in a highly infectious disease, because of that, mobile robots can provide alternatives in the combat of this disease that do not require contact between the sick people and the healthy people.

Mobile robotics has nowadays made many advances and this knowledge is applied in carrying out various tasks; the flexibility in programming these devices allows us to create new applications without the need to make new designs, that is, it allows us to readapt the designs to current needs.

With the appearance of the Covid 19 pandemic, mobile robots have become a very useful tool to combat the virus, since the spread of the disease can be reduced by not having human-human but human-machine interaction; applications that have been developed are very varied from the transport of medicines and food to the sterilization of hospitals and public spaces.

This work is organized as follows, first the actual applications of mobile robots fighting against Covid 19 are presented, then their uses in support services, next the application for industrial environments and finally, their uses at Hospitals and day to day activities are discussed.

II. MOBILE ROBOTS APPLICATIONS

Nowadays the applications of robotics in the areas of defense, rescue and security are increasing considerably since new terrorist and biological threats. There is a very notable development in robots that help in some way to face this problem, at the same time, a lot of research and large amounts

of money are being invested in these fields in order to design more versatile and efficient devices, with the appearance of integration of new technologies such as: internet of things, cloud computing, artificial intelligence, among other areas the development of sophisticated and complex devices continues to grow.

These robots generally perform tasks such as explosives deactivation, reconnaissance, surveillance, rescue, military activities, and some interventions that includes biological or chemical contamination. The use of mobile robots in these areas is motivated by the need to facilitate the execution of activities in highly dangerous environments for humans and by the appearance of new biological and terrorist threats.

These robots can be fully controlled semi-autonomous or fully autonomous and are used in situations and activities that represent a huge danger to humans. They normally work in hostile environments that are difficult to access and very complex environments or poorly structured.

Due to the intrinsic characteristics of the missions entrusted these robots are designed with a high degree of flexibility, reliability and versatility, all these features are combined with cognitive abilities for self-diagnosis and reconfiguration as well as localization capabilities, navigation, perception, and adaptation to changes in the mission and the environment.

Typically, robot designed for these applications include multiple cameras, ultrasound sensors, laser scanners, gyroscope, accelerometers, inertial mass units (IMUS), laser pointers, microphones, horns, and normally are controlled by a radio signal.

In recent days, the interest in this type of robot increased with the appearance of the Covid-19, since this type of mechanism can greatly help the tasks performed by medical staff, this is the reason why the market for mobile robots is having a slight increase as will be discuss later.

III. ACTUAL APPLICATIONS AGAINST COVID-19

Robots play an important role in the fight against the SARS-CoV-2 coronavirus worldwide. Since cases of Covid-19 coronavirus infection have skyrocketed, citizen initiatives have been growing to fight the pandemic, which threatens a deep economic recession. Various innovations have been used at the professional level by health services in different countries.

The infection attacks constantly and increasingly, tools such as care robots, drones or monitoring applications are allowing to fight it. Due to the amount of mobile robots that have different types of functions, an lot of applications can be developed to mitigate the causes and consequences of Covid 19.

IV. ROBOTS FOR SUPPORT SERVICES

Due of the ease and high level of spread of Covid 19 there is a need for compliance with stringent health and safety protocols that prevent the free development of day-to-day activities of the population, for better control of the execution of these restrictions and raise awareness of society it is possible to build applications through the use of mobile robot that promote good practices.

A. Population awareness and control

Reliable Robotics is a company that rent robots for events and entertainment in general, due to the pandemic has reprogrammed the functioning of their robots and has adapted to perform activities such as the detection of fever, distribution of hand sanitizer, sterilization of spaces and resolution of doubts and medical questions about the coronavirus (Fig. 1).



Fig. 1. Pepper from Reliable Robotics

Pepper is a small white humanoid robot of 1.20 meters in height, 28 kg of weight and with capacity to operate for some 12 hours, and is probably the most sociable of the small family of four robots developed recently by Reliable Robotics. This robot understands and speaks 15 languages and is capable of detecting emotions in people and possess facial recognition, making it able of raising awareness and educating people about the virus through conversations.

Pepper can help doctors to communicate with their patients remotely without being in the same room, helping to limit contact with the infected to prevent contagion. [1]

B. Delivery services

Also, the coronavirus pandemic has forced self-driving car companies to temporarily shut down their operations and ground their fleets. But mobile robots realized it could still play a role in delivering goods for health care workers by using

its R2 prototype vehicles. These lightweight electric vehicles are built from the ground up to be completely driverless and, with slight alterations, could also provide contactless delivery (Fig. 2), mobile robots are ferrying food, personal protective equipment (PPE), clean linens, and other supplies to workers at two facilities. Human workers load and unload the vehicles at either end of the route, vehicles require the delivery recipient to input a code on a touchscreen to make the doors open. But to make it truly contactless, workers are only required to give a thumbs-up to the vehicle's camera.



Fig. 2. Self-driving stores and delivery vehicle

V. ROBOTS FOR INDUSTRIAL APPLICATIONS

The shortage of medical supplies for the fight against Covid-19 has generated the need to accelerate the production processes and even required companies outside this area to redesign their processes in order to meet this demand, for which robots of all type, including mobile robots, have had to reinvent their functions; in addition, the use of mobile robots also allows adequate compliance with security protocols within the plant.

In the supply chain, autonomous mobile robots are a key component of any automation strategy and a very effective tool to reduce the loss of time and human resources in intra logistical processes. AMRs are collaborative and related to work alongside humans. Allow the automation of any process that requires the safe transport of materials or merchandise around a warehouse or between a production line and a warehouse. They are easy to program and integrate without making changes to the existing factory layout, can free two employees full time to perform higher value tasks, as well as increase productivity and operational efficiency. [2]

Companies like Ford have used their resources to manufacture artificial respirators (also called medical ventilators) and face masks (respiratory protection, surgical, self-filtering, face masks, face masks). [3]

In the short term, manufacturers will wonder how robots can allow them to continue production while allowing an acceptable social distance between their employees. Instead of a person pushing a cart with materials from a warehouse to a job site, for example, we could load an AMR on the job to avoid possible cross-contamination. AMRs can also

provide relief from shortages of production and warehouse personnel due to security restrictions or sick leave. This issue is especially relevant for various industries, such as pharmaceuticals or consumer products, which have to face massive spikes in demand for certain products at the same time that their human resources are sometimes under great pressure.

Mobile Industrial Robots (MiR) offers mobile robots for the movement of loads within the industrial, instead of a person pushing a cart with materials from a warehouse to a workplace (Fig. 3), for example models like the MiR500 allows to see all obstacles within a 360 ° radius navigating autonomously and finding efficient routes to a destination in dynamic environments where people and vehicles move. With a lifting capacity of 500 kg and with speeds of up to 7.2 km/h all these characteristics make it ideal to avoid excessive contact between workers, avoiding contact risks. [4]



Fig. 3. Mir500 from Mobile Industrial Robots

VI. ROBOTS FOR HOSPITAL SERVICES

Given the nature extremely contagious of the new corona virus is very difficult for medical personnel to respond directly to patients or potential cases without protection, respirators, goggles, gloves or gowns that are in short supply in times of emergency as in the present

A. Disinfection of facilities

The need to decontaminate rooms with possible contamination is extremely important to avoid the greatest possible spread, which is why it was necessary to use a mobile robot capable of cleaning an area and thus avoid contagion. The UVD disinfection robot has been very useful since the beginning of the outbreak of the pandemic. They began to destroy viruses in Wuhan, where the global pandemic began and now the units operate in more than 40 countries, including the United States and countries in Asia and Europe. UVD Robots (Fig. 4) combine in-depth microbiological knowledge, moving autonomously through patient rooms and operating theatres, covering all critical surfaces with the right amount of UV-C light to kill specific viruses and bacteria. The more light the robot exposes to a surface, the more harmful microorganisms

are destroyed. In a typical patient room, almost of all viruses and bacteria are killed in minutes.



Fig. 4. Virus killing Ultra Violet-Disinfection Robot

The robot disinfects all contact surfaces, stopping at pre-determined focus spots that require longer exposure and re-positioning itself close to surfaces to effectively eliminate any shadows where infectious organisms could avoid the ultraviolet light, While it hasn't been determined if UV-C light can kill COVID-19, it does have that potential, having been proven effective against other coronaviruses such as SARS. The robot comes equipped with safety measures to protect humans from radiation, including a tablet that functions as a motion sensor, automatically switching off the UV-C light when someone wants to enter the room. [5]

B. Transport of material and supplies

In this case the applications focus on material delivery operations of pharmaceuticals, linens, food and trash. In addition, AMRs can be used for tele-presence enabling doctors and nurses to make their rounds and visit patients remotely. This is a use case which may become critical if the crisis devolves to a large scale pandemic and the number of patients increases to the point that it's logistically difficult for doctors to visit patients (and reduce their exposure).

Zealand University Hospital in Denmark received daily autonomous deliveries from the hospital's sterilization center. The implementation of a mobile robot from Mobile Industrial Robots (MiR) make possible a flexible and automated logistics (Fig. 5) throughout the upcoming 190,000 square meter super hospital. [6]

It is important that if a fleet of autonomous mobile robots is used, there is adequate logistics for use in hospitals; to achieve this objective, different methods can be used, such as First Order Search (MT-FOS) that is very simple, when a delivery is requested the closest robot will attend to the order; another option is to use the Combinatorial Search Method (MT-COM), which consists of searching for all the possible path combinations of the robots and selecting the least difficulty combination with the shortest distance. [7]



Fig. 5. MiR delivering hospital equipment

C. For communication without direct contact

The communication devices in hospitals are nothing new but due to the pandemic, the need to communicate between the medical team and patients without having direct contact has forced to give a solution through the use of mobile robots (Fig. 6).

Companies like Ohmnilab offer remote operation AMR's for teleoperation / telepresence that are useful in the Covid-19 crisis as they provide solutions for remote workers and also in health care to remotely monitor patients by nurses and doctors. [8]



Fig. 6. Hospital communication in times of Covid-19

D. Cleaning of facilities

In hospital facilities, cleaning is an important factor, that there is a good cleaning team is vital for the development of these activities, but due to the current conditions caused by the covid-19, hospitals are a high-risk focus, so for To reduce this risk, actions must be taken, a possible action is to reduce the ease of contagion by replacing the current cleaning equipment with mobile robots, there are currently autonomous robots that perform disinfection and cleaning tasks, due to their flexibility it can be adapted for this type of situations, in this way we can reduce the personnel assigned to these tasks to save lives.

Companies like AvidBots have autonomous cleaning robots that adapt well to these needs since their programming allows them to carry out cleaning tasks effectively without interrupting the hospital activities that are being carried out, they can

also be programmed to perform their functions at specific times or when the facilities are not operating. [9]

VII. ROBOTS TO HELP IN DAY-TO-DAY ACTIVITIES

The use of mobile robots against pandemic of the Covid-19 can be very wide and there are possible applications that have a relatively small impact but always give a contribution; Specific activities that can be accomplished with the use and design of new mobile robots and that also reduce contagion can be very useful.

In many countries there are strict restrictions of people movement in the streets. This is done in order to maintain a social distancing and thus decrease the amount of people infected with the virus.

For those who have pets, with this measure, it is almost impossible to go out and visit parks or make small tours with reasons for distraction or relax. It is in this case that mobile robots have not ceased to provide assistance in this area, such as, for example, there are users who have adapted their drones and turned them into a tool that serves to take their dogs without the need to violate the restrictions (Fig. 7), [10].



Fig. 7. Drone walks dog during Covid-19 lockdown

VIII. FUTURE OF MOBILE ROBOTICS AGAINST PANDEMICS

Digital health technologies are fundamental tools in the ongoing struggle against the global pandemic Covid-19.

There is no doubt that the use of Artificial Intelligence (AI) and robotics can provide valuable and innovative solutions for the treatment of the patient, the front line protection, risk reduction, communications and improving the quality of life under lock as for example in China. However, it is understandable that this type of technology is not readily accessible to all countries, and that its acquisition in these moments is a very high price, taking into account the basic needs that must be addressed.

Robotics has become one of the great allies against the outbreaks, as has happened in the year 2015 with Ebola. And it is to be hoped that over the next few years, the introduction of the robots in the medical sector is increasing, especially to combat cases of emergency such as the one is living. [11]

REFERENCES

- [1] Atalayar. (2020) Los robots también se adaptan al mundo covid-19. [Online]. Available: <https://atalayar.com/content/los-robots-tambi%C3%A9n-se-adaptan-al-mundo-covid-19>.
- [2] F. Fandiño. (2020) Fernando fandiño: Robots móviles para impulsar las cadenas de suministro en un mundo pos-covid. [Online]. Available: <http://www.automaticaeinstrumentacion.com/es/notices/2020/05/fernando-fandino-robots-moviles-para-impulsar-las-cadenas-de-suministro-en-un-mundo-pos-covid-46587.php.Xu7M8WhKhPY>
- [3] M. Hernández. (2020) Ford y 3m presenta los primeros respiradores con purificación de aire para proteger a médicos. [Online]. Available: <http://www.mundoempresarial.pe/automotor-mundoempresarial/2617-ford-3m-respiradores-purificacion-aire-medicos.html>
- [4] MiR. (2020) Mir500 — mobile industrial robots. [Online]. Available: <https://www.mobile-industrial-robots.com/en/solutions/robots/mir500/>
- [5] E. Demaitre. (2020) Uvd robots responds to surging demand during covid-19 crisis. the robot report. [Online]. Available: <https://www.therobotreport.com/uvd-robots-responds-surging-demand-during-covid-19-crisis/>
- [6] M. Oitzman. (2020) Robotic solutions for covid-19. [Online]. Available: <https://mobilerobotguide.com/2020/04/01/robotic-solutions-for-covid-19/>
- [7] S. Jeon and J. Lee, “Performance analysis of scheduling multiple robots for hospital logistics,” in *2017 14th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI)*, 2017, pp. 937–940.
- [8] O. . H. of the Ohmni Robot. (2020) About telepresence. [Online]. Available: <https://ohmnilabs.com/products/ohmnirobot/>
- [9] J. Kahn. (2020) Cleaning robots have their moment in the fight against covid-19. [Online]. Available: <https://fortune.com/2020/06/01/cleaning-robots-sales-soar-coronavirus-pandemic/?k2s7bd>
- [10] J. A. R. Murphy and V. Bab. (2020) How robots are on the front lines in the battle against covid-19. [Online]. Available: <https://www.smithsonianmag.com/innovation/how-robots-are-on-front-lines-battle-against-covid-19-180974720/>
- [11] I. Argueta. (2020) ¿cómo pueden ayudar los robots a combatir el covid-19? [Online]. Available: <https://iat.es/blog/robotica-coronavirus/>