Robotics, AI and IoT Applications in Medical Treatment during the Pandemic

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Abstract

Using current technologies, many nations have swiftly responded to the unanticipated Corona-virus disease 2019 (COVID-19) pandemic. Robotics, Artificial Intelligence, and digital technology, for instance, have been used in hospitals and public spaces to preserve social distance, minimize person-to-person contact, enable quick diagnosis, monitor viral spread, and provide sanitation. In this article usage of technology in the pandemic situation is discussed and several examples are given to better understand its implementation specific to COVID-19 scenario.

Keywords

COVID-19 pandemic, robotics, digital technology, healthcare

1. Introduction

The World Health Organization (WHO) declared a global emergency (COVID-19) as a result of the SARS-CoV-2 new corona virus outbreak on January 30, 2020. With 266 instances, Wuhan city, China, had the first indications of this pandemic in December 2019. Later, from 100,000 instances in the first week of March to more than one million cases on April 2, the verified new corona virus cases surged tenfold in less than a month. Nearly all nations had negative effects from the COVID-19 epi-

demic, which also caused severe strain on healthcare systems and economic issues.

In order to respond to the disruptions brought on by this epidemic, study the illness, and stop the spread of infection, many nations immediately utilized existing technologies. Robotics, artificial intelligence (AI), and digital technologies, such as the Internet of Things (IoT) with next-generation telecommunication networks and bigdata analytics, are the key subsets of these technologies. In order to lower the frequency of COVID-19 infections and improve patient care, they are employed in sanitation, disease diagnostics, resource distribution, contact tracing, surveillance, and social control, which is the act of preventing or restricting human mobility. In this study, three kinds of COVID-19 pandemic-related technologies—robotics, artificial intelligence, and digital—are given.

In this study, we came to the conclusion that robotic technologies integrated with AI which can be digitally operated are very important in the present and future. The same is very useful at the time of pandemic. The present paper deals with the market and applications of robots and technologies like AI.

Accordingly, the remainder of the survey is organized as follows. Section 2 presents a preliminary background of robotics technologies. Section III surveys the developments in AI field. Section 4 discusses research digital technologies and cost. Finally, Section V concludes this study.

2. Robotics Technologies

In the world of medicine, robots take on a number of tasks that require specialized human treatment and surgery. This technology can fill the gap left by a lack of medical professionals in a remote area. Robots can be programmed to carry out the necessary task, and this technology can be used to carry out the risky human task. There was a rise in the use of robotic applications in the clinical field during the Covid-19 crisis. Robots offer special benefits for increasing productivity and stopping the spread of viruses. Robots that can detect temperature, for instance, have been used to monitor public health. Robots used in telemedicine can lessen intimate contact between infected patients and their caretakers. The potential uses of robotic technology during this epidemic and in the future seem endless, whether they are implemented in locations with a high risk of infection, like hospitals, or in public spaces.

2.1. Sanitation

In the case of communicable diseases like COVID-19, cleaning and cleanliness are unavoidably crucial for ensuring healthy indoor and outdoor settings. One such robot for disinfection is UVD-bot. It is an autonomous germ-killing robot that works with ultraviolet radiation (UVC-254 nm). The corona virus is effectively neutralized by the UVC light employed in this robot because it causes problems with DNA base pairing. Another illustration is the employment of the Softbank Robotics-produced robotic Hoover. Whiz in Tokyo hotels was accommodating the Covid-19 patients with moderate symptoms.
Due to the inbuilt AI system BrainOS, which determines the optimal path across the environment and avoids barriers like stairs and human movement, Whiz may be used in open situations.

Then there is a robot by the name of iMap9 (Milagrow iMap9) [5] that uses a more traditional approach to disinfection. In accordance with the ICMR's recommendation, the iMap9 uses NaOCl (sodium hypochlorite) solution to clean the surface of COVID-19-carrying spores. The Nanyang Technological University created the disinfection robot XDBot [6], which can be operated via a laptop or tablet. Positively charged cleaning agents are sprayed by the XDBot onto negatively charged surfaces using an electro-statically charged nozzle.

2.2. Delivery and hospitality

To lessen the impact of the pandemic, many methods have been developed for delivery in both hospitals and the general

population. Pudu Technology's autonomous service robots are now being deployed in Wuhan to bring prepared meals and medication to persons who are being quarantined.

Large quantities of everyday essentials and medical supplies can be delivered to hospitals and residential complexes using the larger autonomous cars, which are currently produced by JD Logistics, White Rhino Auto Company, and Meituan. Smaller vehicles, like the Robopony from ZhenRobotics, are utilized for "last-mile delivery" in non-motorized areas. They are made to transport smaller quantities of food and supplies so that individuals can remain at home.

One example of a hospitality robot is Sona 2.5 [7]. It was created with the use of intelligent obstacle avoidance technology, has a vision camera for facial recognition, and can transport up to 15 kilograms', making contactless delivery possible.

2.3. Patrolling and Screening and Telepresence

The employment of tiny, autonomous robots to patrol hotels, such as Beijing's "quarantine hotels," to monitor the quarantine situation and deliver food, bottled water, and other packages to persons self-isolating is a novel application of robotic technology to facilitate social separation in high-risk settings. Boston Dynamics' dog-like robot Spot is now being tested in Singapore to assist the volunteer Safe Distance Ambassadors in alerting the public when safe distances are not being maintained. Temi is a personal, AI-powered, self-navigating robot that has been customized to be used in busy or high-risk places, such hospital entrances.

One of Ubtech's anti-epidemic robots, Atris is an outdoor screening and patrolling robot. It has a comparable set of sensors for screening, including LIDAR and IR/optical cameras. The portable robot NIGA-BOT, which can conduct real-time video and audio conference calls between patients and doctors, is an example of how a robot can be used in telepresence.

2.4. Market of Robots in healthcare

The use of robotics and automation in healthcare and other fields is expanding daily. The figure 1 shows the worldwide market of the medical robots from 2017-2022, It was observed that the demand of robots was higher in 2017 as compared to 2018 after that it was linearly increased up to 2021 and in 2022 it was abruptly increased by approximately 35%. It is expected to increase the demand for robots in the healthcare market in future.
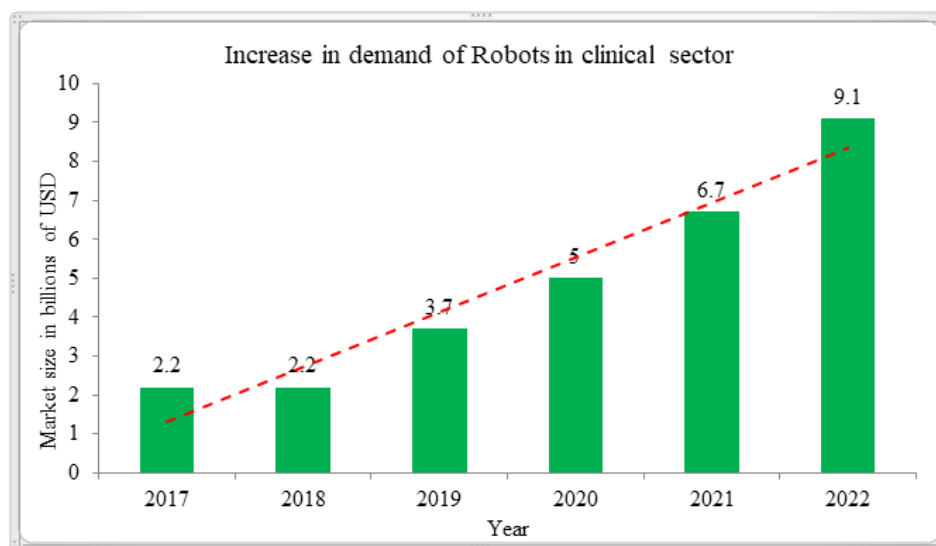

Figure 1. The medical robots used worldwide from 2017 to 2022

The various applications-based robot market of 2017 is shown in figure 2 and the market was simulated from old data and

the expected demand is also presented for 2027. It is noticed that the highest demand was observed of receptionist robot and after that slightly lower demand of nursing robots. Now the lowest demanding robots are for disinfecting robots and in future it will be growing smoothly and observed that the lowest demanding robot in future will be teleoperation robots.
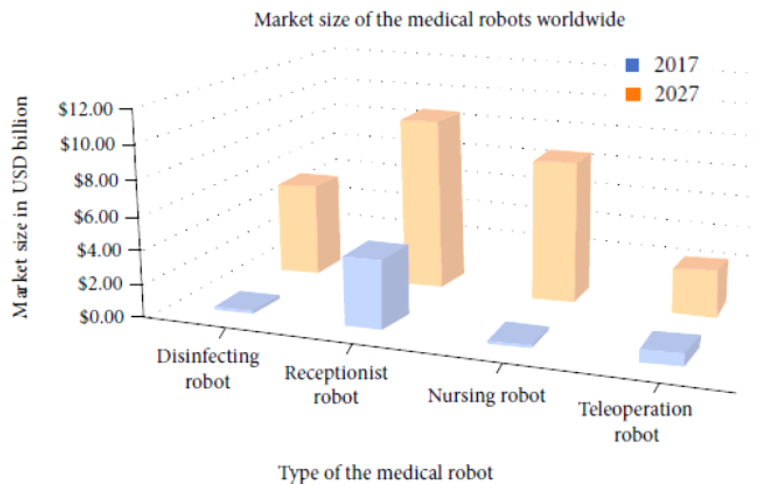

Figure 2. The expected market size of various medical robots used worldwide 2027 as compared to 2017

3. AI Technologies

During the COVID-19 pandemic, AI has the potential to support healthcare in an innovative way. The effectiveness of healthcare professionals has greatly increased, and diagnosis times have decreased. : Categorization of AI and Robot system based on AI and robotics in Healthcare is presented in figure 3.
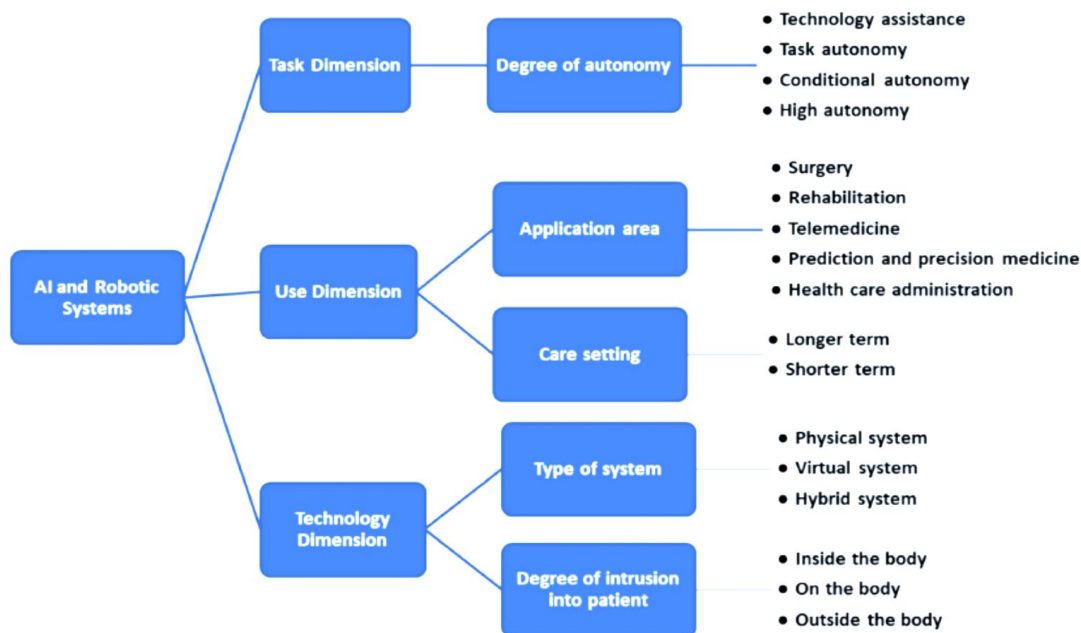

Figure 3. Categorization of AI and Robot system based on AI and robotics in Healthcare

3.1. Health Care

Since reverse transcription polymerase chain reaction (RT-PCR), the conventional approach, is much slower than CT examination, it has become crucial to swiftly diagnose COVID-19 cases. Alibaba created a technique that uses AI to analyze suspected COVID-19 cases genetically. Due to the ongoing updating and change of facts regarding the disease, COVID-19 is not fully understood.

In order to provide frontline doctors with the most recent information regarding COVID-19 and its management, the National University Hospital (NUH) and Tan Tock Seng Hospital (TTSH) developed "Bot MD," an AI toolkit. It gathers evidence-based clinical information from medical associations, the Ministry of Health of Singapore, and volunteer doctors.

3.2. Detection of Potential Cases in Public Area

AI has the ability to assist healthcare professionals as well as identify possible COVID-19 instances in the general population. Fever is a typical indication of the illness; therefore, one way involves employing an AI-powered system integrated with infrared technology to monitor a person's temperature. This technology has been created by SenseTime [11] and Megvii Technology Limited, and both of them can screen up to 10 or 15 people/s with an accuracy of 0.3°C. These devices can still function well when users are donning hats and facial coverings.

4. Digital Technologies and Cost

4.1. Tracking

The spread of the virus may be tracked and those who could be at risk of getting sick could be warned by mapping out the locations and contacts of COVID-19 patients during the predicted infectious period. Examples include the "StayHomeSafe" app introduced in Hong Kong in 2014 and the FluPhone, which was introduced in 2011.

4.2. Health Care

The COVID-19 pandemic has forced further advancements in medical technology in addition to tracking. Following the COVID-19 outbreak in Wuhan, a pilot system was established in under 72 hours by a team of 40 professionals and introduced in Honghu. To deliver real-time data, the Honghu Hybrid System (HHS) brought together case report systems, electronic medical records, and social media platforms (such as WeChat). To lessen the impact of the epidemic on business, platforms for commerce including Alibaba, Amazon, McDonald's, and Starbucks have implemented no-contact purchasing and delivery.

4.3. Cost for Healthcare Robotic Solutions

Since there is a high need for healthcare robotic solutions, they must be affordable for simple installation and widespread availability around the world, especially poor countries. Because these technologies are expensive, scaling may not be possible in most regions of the world. However, it's a cutting-edge technology and built-in high-definition video systems for tool guiding and physician maneuvering, surgical robotic systems are highly expensive [12-13].

5. Conclusion

During the COVID-19 epidemic, robotics, AI, and IoT significantly aided in the situation and demonstrated their bright future in society. Some of the main obstacles during the pandemic period are maintaining social distance, minimizing per-

son-to-person contact, ensuring rapid diagnosis, monitoring virus spread, and providing sanitation. This article looked at current technologies that had been modified to combat COVID-19. The use of these technologies has been expanded to include patrolling, screening, diagnosis, health consulting, and viral tracking, as well as cleanliness for hospitals and public spaces. Lessons from the COVID-19 pandemic can be applied to respond to pandemics more effectively in the future. After the pandemic, hastening the creation and application of new technologies will increase the pool of already-developed technology.

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