e-ISSN 2320 –7876 www.ijfans.org
Vol.11, S Iss.2, 2022

Future of Robotics in Healthcare

Dr. Anjum Qureshi
Assistant Professor, Rajiv Gandhi College of Engineering Research & Technology, Chandrapur, India

Abstract:

Good health is a primary requirement for every human being. The recent technologies are used by the medical professionals to enhance the results of diagnosis. The technologies help in reducing errors and giving the results of diagnosis in less time as compared to the conventional methods. Robotics is one such technology that has revolutionized the medical industry. It has proved to be very useful for in the health sector due to its versatility. This paper wills discuss some of the applications of robotics in health care and few other technologies that are being used with robotics for better results.

Keywords: Robotics, Healthcare, Surgical, Medical

INTRODUCTION

There is a famous saying that fits everyone's life: "Health is wealth". Each one on this earth wants to lead a healthy life. Polluted environment, busy lifestyle, lack of exercise and poor dietary habits are some of the factors that has made it difficult to maintain a good health and maintain a healthy lifestyle. The health care science & technology have benefitted the medical industry by making the treatment more effective. One of the technologies that are extensively being used by the health experts is robotics.

Robotics is a convergence of science, engineering and technology that produces machines called as robots. These robots recreate human actions and are used as substitutes for humans. A robot is thus a programmable machine and robotics is the field of study that concentrates on producing it. Some common characteristics of robots are: (i) they consist of mechanical construction that helps the robots to accomplish the assigned tasks in the environment for they have been designed for. (ii) They require electrical components to control them and fulfill the power requirements, and (iii) some level of computer programming that enables the robot to carry out the given task. Due to the advances in software and technologies like the artificial intelligence, the present day robots have become smarter, more flexible and more energy efficient. The robots are therefore capable of performing the tasks that humans can never think of doing it alone. Robots can be used in various ways and very soon we will be able to see robots everywhere like in hospitals, hotels and may be also on roads. Some of the common applications of the robotics include: (i) carrying and assembling the industrial equipments (ii) Assisting surgeries and carrying medicines (iii) Helping in household chores and entertaining the children. (iv) Logistics robots that help in taking the

items off the shelves, transporting and packaging them (v) search and rescue operations after natural calamities. (vi) In military operations for detection of landmines in war zones. In this article we will try to discuss about how the robots are proving helpful in the healthcare industry, the technologies that can improve the performance of robots in health care and few future aspects of robots in this field [1].

APPLICATION OF ROBOTICS IN HEALTHCARE

The robots in the field of health care are generally categorized as medical robots and surgical robots. The medical robots are helpful to the doctors when they have to examine a patient at remote location. Such robots are called as "telepresence" robots. The rehabilitation robots help the patients in performing certain movements during the post-surgical state. The companion robots are often utilized for the care of elderly peoples as help in reducing anxiety and loneliness that has been induced as a result of depression. Many applications in the health care sector use surgical robots. They can be used for performing organ transplants, spine surgery, urological operations and gastrointestinal procedures. They assist the surgeons in surgical procedures like making precise incisions and have helped in developing novel methods to perform minimally invasive surgeries that would provide a faster recovery to the patients [2] .

The medical transportation robots perform tasks like transporting medicines, dispensing of the prescribed drugs, delivering food to the patients and staff thereby allowing enhanced communication among the patients, doctors and staff. Such robots are a boon for the health care workers as they can focus more on the patients due to the tasks handled by the robots. With the outbreak of pandemics like Covid-19, the healthcare sector is concentrating on sanitation and disinfection robots that can clean and disinfect surfaces of any bacteria and viruses within minutes. The speed and accuracy are the two features that have proved to be a boon for the health care sector. These qualities of robots are used in robotic prescription dispensing system in which the robots handle powder, liquids and highly viscous materials efficiently [6].

COMBINING EXISTING TECHNOLOGIES WITH ROBOTICS

The existing technologies can be combined with Robotics to increase its effectiveness in health care. Some of the technologies that are being used with robotics are Artificial Intelligence (AI), Internet of Things (IoT) and Blockchain.

AI enabled robots perform many functions without human intervention. These robots are trained through computer vision technology for detecting objects and visualizing different situations. The computer vision technology is used to train the machine learning algorithms to learn some defined patterns for prediction of results from the precisely trained data sets. The data set consists of annotated images of the object that enable detection of objects in different situations and in different shapes and sizes. Combining AI with robotics has restructured the health care sector by offering remarkable solutions for medications. AI enabled robots are considered to be a

boon to the health care due to the following reasons: (i) They perform tasks with improved precision, increased strength and without any shocks of the knives by using software that are set to perform the undergoing tasks. These technologies when used with machines like mechanical arms and surgical equipments will give more flexibility and precision as compared to human abilities (ii) The AI enabled systems can provide precise diagnosis by scanning number of reports and apply correlations between hundreds of variables that have not been mentioned in the existing health care works. (iii) AI enabled robots can be used for remote treatment (iv) Monitoring health of the patients, assisting the patients to walk or to go for a check-up can be done very quickly by using the automated machines. These tasks can be time consuming when done manually [7].

An IoT aided robotics system some basic functionalities like perception, motion ability, interaction ability, cognitive ability, manipulation, adaption and decision making ability. The perception ability of a robot in health care environment can be used to observe human behavior like unhealthy habits and abnormal behavior of patients. The sensing and data analytics properties of IoT help the robots to sense and collect the correct information irrespective of their locations. The information about the location of a robot is essential to collect environmental information. The IoT based technologies like RFID, Bluetooth, Zigbee help in solving the problem of localization. Motion ability is another significant characteristic of a robotic system as it increases the working range of the system. The working range of a robot can be increased by using latest mechanical design and effective navigation technology. The navigation system is required in creating a map of the environment to allow safe navigation and avoid collisions. The interaction ability of an IoT aided robots makes the system user friendly and more efficient by enabling interaction with the users, operators and other systems in the given environment. The cognitive abilities are required for fulfillment of aspects like perception, intelligence, problem solving, thinking and encoding and decoding of information. An IoT enabled robot used in health care uses cloud to obtain information regarding human body and its surrounding environment. The integration of IoT with robotics helps in processing of health data that can be used by the doctors to decide the best methods of treatment. Integration of sensors into the robots increases the decision making ability of the IoT aided robots that helps in better prediction. Another important characteristic is adaptability that helps the system to deal with conditions like change in environment or change in human behavior. Perception, cognitive and decision making are few abilities that help achieve adaptability for a robotic system [8].

Some of the fields where IoT and robotics technology have been used for health care are : covid 19 management, care of elderly, prosthetics, rehabilitation, and assistive surgery.

(i) Rehabilitation: It plays an important role in the recovery of patients with motor disability. Brain injury, stroke and chronic pain are some of the reasons behind motor disability. Rehabilitation training is sometimes difficult due to unavailability of trained staff, high expenses and geographical barriers. IoT and robotics when combined, reduce the

difficulties involved with the rehabilitation. These systems allow the doctors to remotely monitor the rehabilitation training and provide optimal prescription based on it.

(ii) Assistive Surgery: Robotics has provided a flexible environment to the surgeons by making the surgeries more precise and accurate. Combining IoT with a surgical robot helps the doctors and the healthcare staff to connect and communicate with the external devices like sensors, wearables and mobile phones. It increases the operational workspace as compared to the open surgery and allows the doctors to connect for teleoperation using the internet.

(iii) Prosthetics: A patient needs to undergo medical examination and training to become comfortable with the conventional prosthetic devices. Using robotic prosthetic devices along with IoT enhances the productivity of these devices. The rich information base produced by the IoT system and the associated sensors are helpful in reducing the discomfort caused due to the conventional prosthetics.

(iv) Elderly Care: The elderly people have to face physical, sensory and cognitive issues due to which it becomes difficult for them to maintain a healthy life without support of family members or a caretaker. The robots that use sensors and navigation facilities to create a physical environment for active aging are called as service robots. These robots use IoT to connect the elderly people with their family and doctors. The robots provide facilities like interfacing of home appliances, fall detection and reminders for health emergencies by which the elderly are able to maintain a quality of life.

(v) Covid-19 Management: During the pandemic period robots were used to perform tasks like disinfection, sanitizing, delivering medicines and food to the patients and health care staff. Integrating IoT with the robots helps in performing few more tasks like checking if a patient is following quarantine rules, collecting data of body temperature of the patients from remote locations and sending alerts of infection to the patients. All these features helped in avoiding direct contact, prevent infections and help in detecting the disease without physical presence of a doctor.

The medical robots provide high precision and error free operations. As these robots work closely with the health care staff and patients, trust worthy systems is needed to operate and control them. The medical data of the patients is very important due to its connection with health. In case the medical robots get compromised the attackers can alter the acquired data, which may prove to be dangerous for the patient. Blockchain provides a vital framework for the medical robots to enable secure data transmission among the robots and the hospital servers. Some platforms that are commonly used to implement Blockchain are Hyperledger and Etherum [9].

FUTURE OF ROBOTS IN HEALTH CARE

According to the study by Sheetz, Clafin and Dimick in 2020, 1.8 % of the surgeries in 2012 were robot-assisted that has increased to 15.1% in 2021. The increase in the number of robot assisted surgeries in the last decade indicates the increase in trust among the people regarding the robotics system and that the robotic surgeries are becoming more accessible [3]. One more report by Credence Research says that the medical robotics market was valued at $7.24 billion in 2015 and is expected to grow to $20 billion by 2023 at the global level [6]. In addition to the rise of robotics surgeries, the field of health care has observed an increased usage of robots in other applications too. The utilization of robots during the covid-19 pandemic period has transformed the perception levels of people regarding the technology as the robots kept the doctors and nurses safe from infections are assisting in patient screening, distributing medicines, disinfecting surfaces and positioning the medical devices [4].

The future may have more advanced robots that will reduce the recovery time post surgery. The scientists are working for developing microscopic robots called microbots that will be tiny so that they can travel through the body to perform repairs. These bots will be used to perform surgery inside the body without cutting the body parts as done in conventional surgeries. The making of microbots that will be so tiny and controlling them to perform task precisely seems to be difficult. Scientists all over the world are making countless efforts to develop the robotic technology and come up with solutions to provide faster and painless recovery to the patients [5].

A research team led by Gregory Fischer is working to develop a compact, high-precision surgical robot that will operate inside an MRI scanner. One of the technical challenges faced by the team during making of this robot is the powerful magnets used by the MRI scanner. To avoid the problems caused by the magnet the robot and its parts including the sensors and actuators have be made with non-ferrous materials. Another challenge is the development of high communication protocols that will e compatible with the higher level imaging and planning systems. After fulfilling all these requirements one more challenge is the robot should be easy to handle, sterilize and place in the scanner. One more research is trying to put efforts for integrating virtual reality with the rehabilitation robots to broaden its scope of therapy exercise and increasing motivation. In addition to the nanoparticles and nanomaterials used in the existing discoveries, the robotics health care sector may use nanodevices in future that will be loaded with medicines to be injected in the body. These nanodevices will be automatically to the accurate targets within the body. In future, we may be able to use digital tools based on wireless technology that will be ingestible and broadband enabled and will be helpful in monitoring reactions of the body to medications [6].

CHALLENGES OF USING ROBOTICS IN HEALTHCARE

The robots play a significant role in collection and processing of the health data. This raises a number of issues related to the privacy and security of the patient's data [10]. The medical robots used for telerobotic surgerycan face two types of vulnerabilities: (i) End point compromise and (ii) Network/Communication based attacks. The end point vulnerabilities are found when if physical access on either side is compromised for the human operated robots like the drones and the rescue robots. The network/communication based attacks can be easily penetrated in a system as compared to the end point attacks. Eavesdropping or hacking by using malicious nodes are some of the common methods used in communication attacks.

Few more challenges encountered while using robots in healthcare are: (i) the robots require continuous maintenance to ensure its proper functioning. (ii) The robots require higher level communication protocols, imaging and planning systems. It is therefore difficult for the non technical surgical staff to handle these robots. (iii) The cost of the robots remains a major constraint in the adoptability and popularization of the technology.

CONCLUSION

Robots are proving to be a boon for the professionals in the medical and health care sector. It can perform its tasks with reduced errors as compared to humans. It does not experience tiredness and fatigue like human beings and is therefore able to work for longer periods. AI and IoT when combined with robotics help in improving its functioning. Requirement of trained person to handle robots and its high costs are few factors due to which robotics are not used readily everywhere.

Reference:

- Jessica Powers, Robotics Technology, https://builtin.com/robotics, July 2021.
- Mike Thomas, 11 Medical and Surgical Robots Transforming the Healthcare Industry, https://builtin.com/robotics/surgical-medical-healthcare-robotics-companies, June 2022
- Sheetz KH, Claflin J, Dimick J. 2020. Trends in the adoption of robotic surgery for common surgical procedures, JAMA Netw Open. doi:10.1001/jamanetworkopen.2019.18911
- Health Europa, The future of Robotics in Healthcare, https://www.healtheuropa.com/robotics-in-healthcare/106671/, March 2021
- How Robots are Redefining Healthcare: 6 Recent Innovations, https://www.roboticstomorrow.com/story/2022/03/how-robots-are-redefining-health-care-6-recent-innovations/18339/, March 2022
- Mark Crawford, Top 6 Robotics Application in Medicine, https://www.asme.org/topics-resources/content/top-6-robotic-applications-in-medicine, September 2016

- Market Trends, Impact of AI and Robots in Healthcare Industry, https://www.analyticsinsight.net/impact-of-ai-and-robotics-in-the-healthcare-industry/#:~:text=AI%20and%20Robotics%20are%20already,AI%20is%20detecting%20skin%20cancer., March 2022
- Bikash Pradhan , Deepti Bharti , Sumit Chakravarty , Sirsendu S. Ray , Vera V. Voinova , Anton P. Bonartsev , Kunal Pal, Internet of Things and Robotics in Transforming Current-Day Healthcare Services, Journal of Healthcare Engineering, Volume 2021, Article ID 9999504
- U.S.P. Srinivas Aditya , Roshan Singh , Pranav Kumar Singh , Anshuman Kalla, A Survey on Blockchain in Robotics: Issues, Opportunities, Challenges and Future Directions, Journal of Network and Computer Applications 196 (2021) 103245
- Zrinjka Dolic, Rosa Castro, Andrei Moarcas, Robots in healthcare: a solution or a problem?, Policy Department for Economic, Scientific and Quality of Life Policies Directorate-General for Internal Policies, April 2019