Robotics and Automation in Healthcare

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Abstract
As the demand for healthcare services grows, healthcare facilities are finding themselves grappling with staff shortages. Besides, with the increasing risk of highly infectious diseases such as Ebola, some healthcare environments such as isolation rooms are becoming dangerous. Robotic Automation can address these challenges. Medical robotics can bridge staff storages by automating various functions and allowing human staff to focus on core healthcare functions. These technologies can also be deployed in high-risk healthcare environments. This publication discusses types of medical robotics, their applications in healthcare settings, and the ethical implications that surround their use.

**Index Terms: Healthcare, robotics, technology, Automation.**

Introduction

The robotics technology that was commonly associated with the manufacturing industry and logistics sector is now finding its way into the healthcare sector. According to Data Bridge Market Research, the global medical robotics market was valued at $15.73 billion in 2023 and is projected to reach USD 52.31 billion by 2031, with a CAGR of 16.20 percent during the forecast period of 2024 to 2031 [1]. Interest in medical robotics is primarily fueled by the need for more precise and efficient care. The technology helps attain these goals by addressing the following three problems;
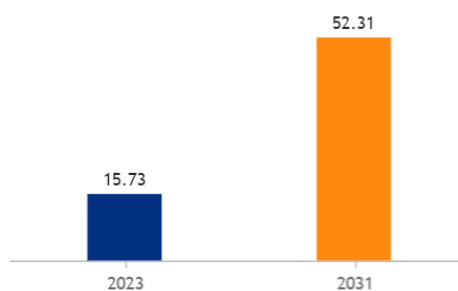
Staff shortage

The number of patients seeking healthcare services is gradually surging across the globe. Despite an increase in the number of people seeking medical services, limitations such as talent supply shortage in labor markets and increasing cost of maintaining healthcare staff are limiting healthcare facilities from increasing headcount. For instance, number of specialists such as neurosurgeons is quite limited worldwide. Besides, the cost of employing these specialists in-house is astronomical.

Robotics automation addresses staff shortages in healthcare facilities in various ways. The technology facilitates remote execution of therapies. For example, the technology allows telepresence. Telepresence entails robotic devices with navigation capabilities and sophisticated cameras for physical examination, acting as an interface between patients and remote care providers. The technology allows distant healthcare specialists to examine patients and prescribe treatments [2]. Surgical assistant robots are remote-controlled machines that allow surgeons to virtually perform minimally invasive operations while seated in workstations outside the operating room. The machines enable specialists from as far as China to conduct surgical operations in Canada.

Medical transportation is another area where robots are helping to ease staff shortage. These machines are designed to map and autonomously navigate healthcare facilities, delivering supplies, medications, and meals to patients and staff. This reduces dependence on human resources and allows specialists such as doctors and physicians to focus on their core functions rather than wasting time moving around the facility. Dispensing machines is another medical robotics technology that is addressing the staff shortage problem. Automated dispensing systems replace human workers in pharmacies and can dispense medication more quickly and accurately than humans. The communication sector is another area in robotic Automation that is addressing staff shortages. Communication robots can be placed in strategic points like reception areas to provide guidance and essential information to facility visitors and patients.

Dangerous roles

The hospital environment can be dangerous. With the increasing antibiotics resistance bacteria and growing risk of deadly outbreaks such as Ebola, the risk of patients and staff contracting deadly illnesses is growing. This is especially true for staff assigned to isolation rooms. Medical robots can be used to replace human caregivers in hazardous environments. These robots can carry tests on patients, provide medical supplies and food, monitor the progress of patients, and even clean and disinfect surfaces.

Long-term care challenges

One of the major challenges healthcare facilities endure is providing care to long-term patients. For example, patients with strokes, traumatic brain or spinal cord injuries, or neurobehavioral or neuromuscular diseases such as multiple sclerosis require long-term physiotherapy sessions to improve their mobility, strength, coordination, and quality of life. Although human specialists can provide functional recovery support, their availability and ability to serve multiple patients is quite limited. Rehabilitation robots can be used to provide functional recovery support to such patients. These machines can be programmed to adapt to the condition of each patient as they recover. The efficacy of these machines can even be enhanced by integrating them with virtual reality, which has proved to be quite effective in restoring balance and motor movements.

medical robot for upper limb rehabilitation

Types of medical robots

Medical robots come in various forms and serve varying functions. Some of the most common medical robots are;

Surgical assistance robots

These are machines designed to augment existing surgical treatments. They can perform minimally invasive surgeries and orthopedic surgeries such as bariatric surgery and knee and hip replacement procedures. Although some surgical robots can autonomously perform surgeries, most of them are remotely controlled.

Modular robots

These are primarily function recovery robots. They include devices like therapeutic exoskeleton robots and prosthetic limbs. These medical robots can take patients through physiotherapy and are used to monitor patients' form as they perform exercise. They can measure the degree of motion and track recovery progress.

Service robots

These are machines created to complement routine logistical tasks. They clean patient rooms, serve patients food, dispense medicine, and track supplies. These machines can also restock medical supply cabinets and transport bed linens to and from the laundry. Some can even conduct tests on patients.

Social robots

Social robots are designed to interact with patients, provide vital information, and schedule appointments. They direct patients and visitors in healthcare facilities, send reminders to patients, encourage patients to adhere to treatment regimes, and cognitively respond to patient inquiries and concerns.

Impact of robotics automation on healthcare

Robotic Automation in healthcare has various benefits. The technology addresses the workforce shortage in the sector by automating monotonous, repetitive, and some administrative tasks, allowing the limited human resources to focus on more critical roles. The technology also shortens the duration of surgeries and increases surgery success rates by eliminating human error in high-risk procedures. They also provide enhanced ergonomics and comfort for surgeons, allowing for increased procedural volumes as surgeons are less fatigued. Medical robots also enable healthcare facilities to share limited specialists. For example, using

surgical assistance robots, a surgeon stationed in the United States can perform surgery on a patient in an operating room in Australia.

Ethical implications

Although the use of robots in healthcare settings offers a plethora of benefits, the use of the technology is not free from ethical implications. Although the technology is marketed as more accurate than human professionals, it is not free of errors. There are concerns about who should be held responsible for errors made by these machines. There are concerns about patients receiving critical information from machines that lack empathy [3]. People are worried about the vulnerability of their sensitive data as they interact with machines. According to Pew Research, 60 percent of Americans say they would be uncomfortable if their healthcare providers relied on robots for diagnosis and prescription [4].

As healthcare facilities embrace medical robotics, it is paramount the assimilation is conducted in a way that recognizes and addresses possible adverse effects of the technology. For instance, the technology must be compliant with data privacy regulations. It is also essential medical robots are closely monitored to protect patients from harm due to malfunctions. Although robots can be used in patient communication, human specialists should communicate critical information such as test results.

Conclusion

Medical robotics addresses various challenges in the healthcare sector. By automating monotonous, repetitive, and some administrative tasks, the technology allows specialists to concentrate on more productive roles. The technology can also be deployed to serve patients in isolation rooms and facilitate sharing of critical human resources. Although medical robots promise to revolutionize healthcare delivery, their deployment should recognize the ethical implications attached to the use of the technology. Their deployment should comply with data privacy laws, they must be actively monitored and should be trained to be empathetic and only deliver general information.

Sources

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