Chapter 12
Principles and Emerging Trends of Healthcare Robotics

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ABSTRACT

Robotics is transforming the healthcare sector by significantly improving precision, efficiency, and patient outcomes across various medical domains. This paper explores the diverse applications of robotics in healthcare, including surgical assistance, rehabilitation, diagnostics, and patient care. Key advancements such as robotic-assisted surgery systems like the da Vinci Surgical System, mobility-enhancing exoskeletons, and AI-driven diagnostic tools are examined. The study also addresses critical challenges, including high implementation costs, ethical and legal concerns, and the need for seamless integration with existing healthcare systems. Despite these challenges, robotics offers immense potential to enhance healthcare delivery, improve access in remote areas, and reduce human error.

1. INTRODUCTION

Robotics is changing healthcare by bringing about new levels of automation, accuracy and efficiency in medical practice and patient treatments. The robotics in

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healthcare are intended to help increase the effectiveness of treatment, minimise human error, and make services more available to people. The robotic technologies are transforming the healthcare delivery processes enabling the surgical assistance, rehabilitation, and diagnostic processes to be safer, more rapid, and reliable. Robotics has found one of its greatest medical uses in the context of robot-assisted surgery. There are systems, such as the da Vinci Surgical System that can enable surgeons to carry out operations on patients in a minimally invasive manner, with even less blood loss and smaller incisions, and also faster recovery times. These robotic systems deliver high-definition 3D visualization and wristed tools that allow similar movements as human beings hand with more dexterity thus reducing risks that come with complex surgeries. More commonly utilized, besides the surgery, robotics has various undertakings in physical therapy and rehabilitation. Exoskeletons and prosthetic robots support mobility-impaired patients in moving by restoring mobility after the stroke or injury of the spinal cord and amputations. Through these devices and the AI as well as the use of sensors, these devices are meant to adapt to patients' movements offering a personalized therapy that is better at recovery rates. Robots are being used in diagnostics and laboratory automation and can automate repetitive procedures such as sample handling, testing and analysis. They eliminate the mistakes of humans, improve throughput and diagnostics improve accuracy. Moreover, the robotic systems are capable of detecting diseases in their early stage with high precision through the help of AI since it analyses medical imaging, including X-rays or MRIs. The other emerging use is telepresence and caregiving robots, which aid in monitoring patients safely at a distance and taking care of the elderly. They are because they can be used to remind them about the medication, fall detection, and even companionship, which is positive to combat the issue of an aging population and shortages in healthcare workers. Notwithstanding these developments, there are still issues such as financial expenses, ethical issues which have to be considered and specialized training. Nevertheless, the field of robotics in healthcare is projected to grow even more with such advancements as nanorobotics (which are used to deliver medication specifically) and the use of AI in autonomous surgical robots. The possibilities of robotics in medicine are limitless to achieve better patient outcomes, market cost reduction, and the availability of medical services to more people across different regions. Robotics will continue to gain relevance in modern medicine as much research and development is done.(Holland et al., 2021; Kar, 2019; Maibaum et al., 2022) Gundoor, T. K. et al., (2022).

1.1 Overview of robotics in health care

Robotics is transforming the medical sector by improving precision, efficiency, and patients care in the medical sector. These state-of-the-art systems include sur-

Professional and Personal Service Robots
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