Chapter 2
Robotics and IoT Enabling Technologies

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ABSTRACT

This chapter discusses the very fundamental technologies like medical sensors, medical actuators, embedded controllers, which facilitate the smooth integration of robotics and the Internet of Things (IoT) in the development of next-generation healthcare services. This chapter explores the different biomedical sensors for different applications different vital parameters to be monitored in real-time. Apart from this, it reviews the emerging force and tactile sensor technologies for accurate and non-invasive diagnosis. Secondly, this chapter introduces several actuators like electric motors, pneumatic and hydraulic systems, which are very important in robotic surgery to prosthetic limbs. The application of microcontrollers for data acquisition, processing, and real-time decision-making is examined, focusing on their application in wearable and implantable devices to continuously monitor and for therapeutic use. Additionally, it is discussing innovations in power management for wearables, data management and biomaterials for creating highly effective medical devices.

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INTRODUCTION

The fast-paced convergence and rapid evolution of advanced technologies such as robotics, Internet of Things (IoT), and intelligent systems is redefining healthcare in the modern era, aiding opportunities for remote patient monitoring. Autonomous technologies are increasingly used in hospitals and clinical settings to minimize human mistakes, enhancing precision while diagnosis, and optimizing outcomes. From surgical robots to wearable biosensors, they are making real-time monitoring, personalized interventions, and minimally invasive interventions possible.

While primary technologies—microcontrollers, sensors, actuators, and wearables—constitute the building blocks of these systems, their value comes in the way they revolutionize the delivery of healthcare. By integrating next-generation computing with adaptive physical interfaces, robotic healthcare solutions can enable real-time monitoring, rehabilitation, and even the automation of sophisticated surgical procedures. Developing innovations like TinyML, energy harvesting, graphene-based sensors, and digital twins are enhancing these capabilities, making more sustainable and smart medical architectures possible.

The aim of this chapter is to discuss the enabling technologies for robotics and IoT in healthcare, with specific focus on their clinical application, adoption issues, and ethics. As opposed to presenting solely a technical overview, the chapter intends to present an integrated view that bridges hardware and software developments to actual medical practice.

ENABLING TECHNOLOGIES IN HEALTHCARE ROBOTICS

Figure 1. General architecture of robotic prosthesis