# Chapter 13
# Robotics:
## Theory and Applications

**Kijpokin Kasemsap**
*Suan Sunandha Rajabhat University, Thailand*

## ABSTRACT

*This chapter presents the overview of robotics; the types of robotic systems; the overview of swarm robotics; the overview of ambient robotics; core ontology for robotics and automation; robotic industrialization and site automation; robotics, cybersecurity, and online threat protection; the robotic applications in modern health care; the robotic applications in surgery; and the robotic applications in modern education. Recent developments in the robotic age have made robots more intelligent, affordable, and user-friendly in modern operations, ranging from manufacturing to health care. Robotic technologies allow for increased production and profit margin because they can accomplish various complicated tasks faster than humans and can produce sophisticated products with higher quality, less down time, and fewer errors than humans. Many benefits of robotics are recognized in cybersecurity, online threat protection, manufacturing, health care, education, business, and finance in the robotic age.*

## INTRODUCTION

Robotics plays an important role in modern society, thus helping people in accomplishing various duties, spanning from assistive operations to industrial assembly, from rescue management systems to military support, and from health care to automation systems (Guizzo & Ackerman, 2012) and performs the specific tasks that most humans possibly cannot do, such as working in challenging conditions and being able to extend the amazing feats with utmost precision (Qureshi & Syed, 2014). Robotics holds a significant promise for improving industrial automation and production lines, operating complex surgical procedures, performing space and security missions, and providing services to assist, educate, and entertain humans (Ghiasi & Larivière, 2015).

Robotics is the innovative industry with an impressive rate of development (Boscoianu, Cioaca, Vladareanu, & Boscoianu, 2015) that embraces artificial intelligence in the individually-thinking robot and the distributed robots (Fong, Deb, & Chaudhary, 2015), toward many advantages, such as those confined to a single space and those that require performance of complex tasks (Al-Naami, Anjum, Aldohayan, Al-Khayal, & Alkharji, 2013). When robots are working in the dynamic environments, there is the requirement to simplify the user interaction and make robotic systems practical (Stenmark & Malec, 2015).

Most of modern robots are equipped with sensing, computing, and communication capabilities, which make them able to execute the complex and coordinated operations (Grieco et al., 2014). Advanced robots have to cope with many different situations emerging at runtime, while executing complex tasks (Ortin, Mendez, García-Díaz, & Garcia, 2014). In recent years, the ability of robotic systems has grown, allowing them to work in the comparably unstructured environments as well as to be deployed in various fields in the digital age (Bock, 2015). Hundreds of universities, corporations, and governments are spending billions developing intelligent robotic systems for the utilization in automation, military, medicine, electronics, food and beverage, service, and a host of other industries (Pruthi, 2012).

This chapter focuses on the literature review through a thorough literature consolidation of robotics. The extensive literature of robotics provides a contribution to practitioners and researchers by describing the theory and applications of robotics in order to maximize the technological impact of robotics in the robotic age.

## Background

The automation of production and daily life tasks has been in focus since the beginning of the 20th century (Chiu & Urban, 2015). Joseph Engelberger is recognized as the inventor of one of the first industrial robots. In1956, Engelberger founded

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