Chapter 3
Transforming Manufacturing With Robotics

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ABSTRACT

The manufacturing industry is undergoing a transformative shift with the advent of intelligent robotics. Intelligent robotics in manufacturing encompasses a range of technological advancements, including collaborative robots (cobots),, and robotic systems with enhanced perception, decision-making, and adaptability. These intelligent robotic systems are revolutionizing the way manufacturing operations are carried out, driving increased efficiency, productivity, and flexibility. One of the key benefits of intelligent robotics in manufacturing is the improved precision and consistency in repetitive tasks. AI-powered robotic systems can perform tasks with incredible accuracy, reducing the risk of errors and improving product quality. Furthermore, the integration of machine learning algorithms allows these robots to adapt and optimize their performance continuously, enabling dynamic adjustments to changing production demands or environmental conditions. This chapter also examines the role of intelligent robotics in enabling mass customization and agile manufacturing.

INTRODUCTION

A manufacturing system that integrates robots and expert systems may be called an intelligent robotics system, which facilitates the mechanization of an intelligent manufacturing process. The concept of intelligent robotics systems has emerged recently by the fusion of the following scientific and technological milestones achieved in different areas during the last years: progress in research dealing with robotics techniques and controllers; research into designing knowledge-based expert system lines and manufacturing cells using expert system techniques for controlling and monitoring individual elements of the manufacturing system; standardization of procedures of data communications and sharing of manufacturing resources among various elements of the flexibly automated system where robots could

DOI: 10.4018/979-8-3693-7812-0.ch003

be present. In addition, progress in research and development of small, reliable, and cheap sensor systems has also encouraged further research work for integrating robots with expert systems. Dedicated equipment can be complex, strong, precise, inflexible, and expensive. By contrast, expert system technology is more flexible and cheap because of the implementation through computer software. It uses common equipment to solve special problems in the realm of knowledge. Robots may also use common equipment to solve special problems when they are under the command of a knowledge-based expert system. They provide a high level of flexibility because they may be programmed to manipulate various components and provide fast computation speed (Phuyal et al.,2020).

Manufacturing processes can be mechanized using different facilities, including mainly dedicated specialized automation equipment and expert systems such as computer-aided design, computer-aided manufacturing, group technology, or robots. Automatic techniques and computerized systems in design and manufacturing are being used to decentralize decision-making to speed up the process of information handling and processing, improve quality control, and optimize the behavior of other facilities in the chain of manufacturing activities. Society's awareness concerning the complexity and high degree of variability of industrial manufacturing is growing. Parallel to this view, the trend toward flexible manufacturing is invading more and more industrial branches, to meet an ever-increasing demand for a variable range of products, characterized by short life cycles (Qu et al.,2019).The adoption of advanced robot systems and manipulators has become a key factor in programs to promote new high-level flexible manufacturing and assembly systems to overcome the limitations of existing technology and to open new fields of application where robots, currently employed for specific tasks, could not be used.

It should be remembered that the robot system, described as a demonstration model in this chapter, is part of a bigger computerized work cell, with single or combined computer control that designs turnkey sophisticated systems. Because of marketplace pressure, work cells like this exist where all robot operations are programmed and executed by a microprocessor that works 24 hours per day, for a long period. The robot system can be installed in any industry that has to repeat tasks many times during the operation of the industry. Investing in the robot system allows the business to reduce its operating costs through the elimination or reduction of human manipulative tasks and by the increase in hourly yield due to the non-stop operation of the robot. The objective is the quick amortization of the initial investment market demand in terms of cheaper and more adaptable systems. In the never-ending list of evolutions undergone by our society, industry requires special mention. With the industrial revolution starting in the middle of the last century, the areas of industrial electronics and robotics also advanced. It seems worth repeating in almost all fields that “necessity is the mother of invention,” and industry is no exception. A handmade product, whether a pin or a large engine, cannot be a marketable item in the present-day world because the number of items required is enormous. The use of hardware as a demonstration model is an initial step. The product is later transferred to a microprocessor-based replicable robot system that is useful in a real industrial layout. In such instances, it offers unperturbed operation without user intervention and the possibility for future commercial applications (Kumar et al., 2023).

This chapter aims to point out how state-of-the-art research and development in intelligent robotics make an essential contribution as an enabling technology to the advanced automation demanded by the constantly increasing market dynamics and product complexity. We consider the challenge of pushing the state of the art towards the true objective of operational human care systems very interesting, integrating the results in medical science and robotics in this way.