


## Chapter 9

# Recognition System by Using Machine Vision Tools and Machine Learning Techniques for Mobile Robots

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### ABSTRACT

*The systems based on image recognition play an important role in many cases where inspection methods are critical for industrial processes. Machine vision is required in industry for monitoring and detecting objects in real-time applications. Industrial robots are increasingly used in a variety of industries and applications such as manipulators and mobile robots. These devices are necessary for dangerous work conditions and tasks that humans cannot do; however, these industrial robots can also do some human activities such as transport material, select, and identify objects. In order to substitute human capabilities is no easy task. Nevertheless, the use of artificial intelligence has been replacing some human activities for increased productivity. By supporting machine learning technologies, this chapter presents a k nearest neighbors' algorithm for image classification of mobile robots to detect and recognize objects.*

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## INTRODUCTION

Throughout history the technological advances have increased the human potential, however, there are 4 key moments that have presented a turning point and represent relevant moments in the societies. The very first of these key events was 18 centuries AD, a period of time during which the artisan production mode prevailed, and the force of motion was provided by natural means like water, beasts, or human beings. With the introduction of hydraulic and steam machine, a great change was made because it revolutionizes the manufacturing industry, mainly in England and it spreads to Occidental world, this was known as The First Industrial Revolution as well as the transportation means like the train and ships which also which helped by these advances (Li, 2017).

The second industrial revolution started a short time later within the birth of electricity and the incorporation of the electromotive force in the industry changes, which revolutionized again the life of the humankind by creating the electric motor and artificial illumination. According to (Mokyr, 1998) the second Industrial Revolution is usually dated between 1870 and 1914.

The Third Industrial Revolution initiates with the invention of computers, through binary logic, perforated cards at the beginning and with the advance in the transistors, integrated circuits, and its miniaturization, where the keystone for the emergence of Analysis and Control elements, for example, the personal computer (PC) and Programmable Logic Controls (PLC), which in the industry helped to increase the automation level and the quality of the processes, controlling those which are whether dangerous or repetitive. In 1969, the charge-coupled device (CCD), was invented by George Smith and the late Willard Boyle. One year later, computer vision first received serious attention (Zeuch, 2000) The use of computer vision in an industrial application is known as machine vision (MV). The widespread use of MV in industry arose in the 1980s. In the mid-1980s, smart cameras for industrial applications were introduced (Belbachir, 2010). These devices can be developed with two types of sensors such as CCD and Complementary Metal Oxide Semiconductor (CMOS). Techniques such as time-of-flight (ToF), laser scanning range finders became available during this era for outdoor mobile robot navigation (Kanade, 2012). These techniques are based on robust computer vision algorithms that allowed the development of the solution of the reliable problem of object recognition in the industry. Other types of algorithms that had a significant impact and gained wide popularity on image recognition and image segmentation in the 1990s were Generic Algorithms (GA) and artificial neural networks (ANNs) (Davies, 2004). In the mid-1990s, the communication and energy created a powerful new infrastructure for his epoch (Rifkin, 2011).

In 2011 appears in Hannover's Technology Fair the 4.0 Industry concept, this means that a Fourth Industrial Revolution has been foreseen and despite it's focused on the industry, undoubtedly, impacts the modern society's daily life and the advances generated by the innovations of direct consuming emerging companies, provided the base to integrate all this technological advances and created an environment, which when it was applied to the manufacturing systems, this industry evolved. Some of the recent advancements in Artificial Intelligence (AI), big data analytics, automation, additive manufacturing, the Internet of Things (IoT), Industrial Internet of Things (IIoT) and evolution of 5G networks are accelerating the change towards a fourth industrial revolution (Singh, 2019).

On a day-to-day basis, we could see elements as IoT, where intelligent sensors of our daily life elements (e.g. coffee makers, cars, smartphones, refrigerators, etc) interact between them and humans through the internet. The capacity to analyze the data obtained by sensors is processed by AI which

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