Chapter 3
Artificial Intelligence for Extended Software Robots, Applications, Algorithms, and Simulators

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ABSTRACT

Robotics has become a rapidly emerging branch of science, addressing the needs of humankind by way of advanced technique, like artificial intelligence (AI). This chapter gives detailed explanation about the background knowledge required in implementing the software robots. This chapter has an in-depth explanation about different types of software robots with respect to different applications. This chapter would also highlight some of the important contributions made in this field. Path planning algorithms are required for performing robot navigation efficiently. This chapter discusses several robot path planning algorithms which help in utilizing the domain knowledge, avoiding the possible obstacles, and successfully accomplishing the tasks in lesser computational time. This chapter would also provide a case study on robot navigation data and explain the significant of machine learning algorithms in decision making. This chapter would also discuss some of the potential simulators used in implementing software robots.

DOI: 10.4018/978-1-5225-9687-5.ch003

INTRODUCTION

Artificial Intelligence (AI) enables a machine to perform actions like learning, reasoning, decision-making and self-correction which resemble certain aspects of human intelligence. AI additionally permits a robot to execute intelligent tasks in real-world environments over extended periods of time. Robots are widely used in assembling, packing, packaging, mining, transportation, earth and space exploration, surgery, weaponry, laboratory research, safety, security and in the mass production of consumer and industrial goods (Khan & Khan, 2017; Rath, 2018; Rath, Pati & Patayanak, 2019; Rath, 2019; Rath, Pati, Panigrahi & Sakar, 2019).

Robots based on functionality can respectively be classified as software and hardware robots. Hardware-oriented robots have a clear set of actions and enable integration of real environments with manufacturers. The first section of this chapter discusses the components of robots and the applications of hardware robots in detail. A software robot is an autonomously re-programmable and multi-functional machine which can shift and communicate like an intellectual and perform automation tasks in any environment. The purpose of software robots is to assist human beings perform intelligent tasks in a more meaningful, creative, rapid and safe manner (Khan & Khan, 2017).

Software robots can be divided into two categories, namely, industrial and service robots. Industrial robots perform the tasks in a specified order and frequently execute the tasks in well-defined environments. Service robot assists human beings in agriculture, natural disasters, medical science and military operations (Kumari, 2014; Priya, 2014; Ruiz, 2017). The different types of software robots with respect to various applications are illustrated in Figure 1 and a detailed explanation of the same is presented in the first section.

Planning, the sub-discipline of AI, will enable the robot to perform a sequence of actions that leads to the desired (target) goal location (Kunze, Hawes, Duckett, & Hanheide, 2018). Planning models, representation of planning models and planning languages are explained in the next section. Robots have to find a collision-free path in the environment and reach the desired (target) goal location. To achieve this, various path planning algorithms and machine learning algorithms are widely utilzed (Galceran & Carreras, 2013; Yang, Qi, Song, Xiao, Han & Xia, 2016; Givigi & Jardine, 2018). Path planning algorithms help in generating a suitable path that can facilitate safe and effortless movement of the robot after tackling the obstacles in virtual environments (2D or 3D). A comprehensive analysis of the different kinds of robot path planning algorithms has been performed and presented in this chapter. The most extensively utilized robotic software simulators have been listed and cross-referenced.

Figure 1. Different types and applications of software robots