Chapter 73
Robots in Medicine:
Past, Present and Future

Hruday Kasina
GMR Institute of Technology, India

M. V. A. Raju Bahubalendruni
GMR Institute of Technology, India

Rahul Botcha
GMR Institute of Technology, India

ABSTRACT

Robots are wide across used in several industrial applications. Robot applications are more found in medical industry in recent days. In initial days, robots were mostly used for simple surgeries and medical applications such as laparoscopic surgery and minimally invasive surgery in 1980's. At that time robotic surgeries were performed with the presence of surgeons in operation theatre. The present day technology has been so much advanced with more enhanced capabilities to perform several complicated tasks such as remote surgery and micro robotic surgery. The current paper discuss about the history and evolution of robots in medical industry and their latest technological advances, applications in various fields in medicine and limitations of robots in medical industry along with its future scope.

1. INTRODUCTION

In present days, robots have occupied major stake in engineering applications. The first robot "UNI-MATE" was introduced by George Devol in the year 1954. It is used in production and manufacturing (Camarillo et al., 2004). Robots were first introduced in medical industry in early 1980's. Based on the role of the robot, they can be classified as active, passive, synergistic, semi-active and intra corporal systems (Smith-Guerin et al.,2008). The active robots play significant role in medical industry than other classification due to their flexibility and adaptability.

DOI: 10.4018/978-1-5225-8060-7.ch073

Robots in medical industry are used for various applications such as diagnosis, support actions during the surgeries and to perform complicated surgeries (Susilo et al., 2009; Zhao et al., 2015; Gomes, 2011; Hockstein et al., 2007).

Robots have been introduced in orthopedics to help the patients to recover from physical disorders (Napper and Seaman, 1989; Xiong et al., 2009). Due to the reason that the medical tasks performed by robot are high accurate and thus leads to low human error.

The master slave robot configuration enables the surgery, even though the surgeon is far from the location of the patient (Schmidt et al., 2014; Bloss, 2012; Lee et al., 2015). The application of robots in treating surgery of tumor offers greater accuracy and flexibility (Bogue, 2011). This enables the doctors or radio specialists to minimize interaction with radioactive environment.

Even though the robots have reached to the greater heights, there exist certain limitations across each medical specialization. The next chapters discuss about classification of robots in medicine, history and evolution of medical robots, capabilities and their enhancement along with limitations.

2. CLASSIFICATION OF ROBOTS IN MEDICAL INDUSTRY

Robots used in medicine are classified into five types according to their actuation and applications (Smith-Guerin et al., 2008). Figure 1 shows tree of robot for each category represents the classification of robots and an example.

2.1. Passive Robots

These are the robots actuated by human operator (Smith-Guerin et al., 2008). The information about the position of the tool relative to the pre-planned data is displayed to the surgeon. The execution of the surgical action is completely performed by the surgeon (Mosges et al., 1989; Lavallee et al., 1994). Dynamic walking robot and AESOP endoscopic positioner are examples for passive robots (Smith-Guerin et al., 2008; Collins et al., 2001).

Automated Endoscopic System for Optimal Positioning (AESOP) represented in Figure 2 is a voice controlled robot which is used to position an endoscope (Stoianovici, 2000). It was developed by Defense Advanced Research Projects Agency (DARPA), Computer Motion Inc. in 1989 and received FDA clearance in 1994 (Hockstein et al., 2007; Unger et al., 1994). It consists of motorized joints where the

Figure 1. Classification of robots in medicine