Chapter

Introductory Chapter: Future of Medical Robots

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1. Introduction

In real life, most of us perform repetitive tasks in factories, school, hospitals and so on. Several people do not like these kinds of tasks and get bored from working offices as well as their jobs. Especially, medical staffs in the hospitals perform thousands of repetitive tasks such as draw blood, make dental filling, visualize patients' vital signs like measuring the human heart rate. Medical staffs make never-ending diagnosis, prevention, and treatment of diseases. As the average life expectancy increases day by day in the world, people are getting older. As the people getting older, the number of patients is increasing more than in the past. As a result of this increase, surgeons execute never-ending surgeries under the pressure of performance; laboratory workers perform never-ending urine and blood tests and dentists always tirelessly remove build-up or decay from teeth. It is possible to multiply these examples.

Being in a hospital is a very stressful experience even in the best occasion. Especially waiting the medical treatment on the que is a tiring practice. In addition, being treated on time is directly related to the country's health staff and technical opportunities. In most countries in the world, due to the lack of medical staff or technique equipment, even for a simple dental filling, sometimes it is necessary to wait in line for months. Medical personnel are often physically and mentally fed up with this endless intensity. At this very moment, medical robots come to the aid of both patients and healthcare professionals.

As an example, robotic medical staffs like robotic nurses, robotic laboratory devices, robotic surgeons can fulfill the boring tasks mention above. Robots are the best candidates to execute the repetitive, monotonous and dangerous tasks without being bored, tired and overwhelmed. According to the market investigations, the market size of surgical robots alone has already exceeded 5 billion dollars.

2. Medical robots transforming the healthcare system

Almost 80 years have passed since the development of the first robot manipulator. Robots, which were originally produced only for industrial purposes, have spread to many areas over time. Today, robots have become equipped enough to work alone in a factory, skilled enough to participate in operations in a hospital, and smart enough to bring a selected product from a shopping mall. The rise of robotic technology and the replacement of workers by robots has become an inevitable reality. It has now become impossible to prevent the development of robotic technology. Now, robots have gained the competence to work in the same office with humans. In the near future, it seems inevitable that some people will completely leave their jobs to robots [1, 2]. At this point, the following question comes to mind. How ready is humanity for this inevitable future? What kind of solutions do social scientists propose for this inevitable future in the world?

The fact that robots have become such advanced devices has had very beneficial results for humanity. Some of these are better diagnosis for everyone, safer surgery, more advanced and yet cheaper prosthetic legs, shorter waiting times and lower infection rates. Some main areas where robots will be employed, especially in the health sector, can be listed as follows: Robot assisted surgery, medical micro robots, rehabilitation robots, advanced protheses and robotic nurses.

2.1 Robot assisted surgery

Until recently, surgeons were performing operations using traditional methods. The most important disadvantage of these traditional methods was to perform the operations by making very large incisions in the patient's body. Therefore, the traditional method has many disadvantages, from esthetic appearance to late recovery. Robot-assisted surgery can eliminate these disadvantages. Robot-assisted surgery is performed as follows: Small incisions are made on the patient's body for the surgeon to operate on the patient using a robot. Surgical instruments and camera are placed to the body from these small cuts. The surgeon performs the surgery using these surgical instruments from a remote console. Since the operated area is magnified several times by means of the camera, the surgeon has the opportunity to see the operational region in more detail than the traditional methods. Thus, the surgeon performs a more comfortable and successful operation. Minimally invasive surgery using robots provides many advantages over traditional methods: i) patient recovers in a shorter time, ii) the surgeon sees the operated area in higher resolution, iii) patients have less risk of infections, iv) the patient returns to his/her traditional life more quickly, and v) economic cost is reduced because the patient is treated in a shorter time. The most famous robotic system used in minimally invasive surgery is definitely the Vinci Surgical System which is used several operations like in cardiac surgery, general surgery, gynaecologic surgery, thoracic surgery, and urologic surgery [3].

2.2 Medical micro robots

Treatment with medical microrobots is an area that medicine has just encountered. These new robotic devices, which are not very similar to the structure of traditional industrial robots, are used to solve the problem in a certain region in patient's body. In general, medical micro robots with spiral tails reach the sick area in the human body by moving through blood vessels. Using this method, the drug can be applied only to the affected area. Thus, healthy area can be prevented from the drug.

2.3 Rehabilitation robots

Rehabilitation robots are intelligent machines designed to help patients regain their lost skills. Rehabilitation robots are used to restore the lost sensorimotor functions, especially in the arms, hands and legs, by making the patient perform programmed exercises. Robotic rehabilitation devices, which are getting more functional every passing day, are used to restore lost skills in the lower and upper extremities. Currently, many types of rehabilitation robots are produced for the rehabilitation of lower and upper extremity regions. Some important commercially produced lower extremity rehabilitation robotic systems can be listed as Lokohelp [4] and Lokomat [5]. On the other hand, some upper extremity rehabilitation robotic systems can be listed as Esa human arm exoskeleton [6], L-exos [7] and Sarcos Master Arm [8].

2.4 Advanced prostheses

Traditional prostheses are devices that allow amputees to perform basic movements while walking. Therefore, traditional prostheses cannot fully perform human hand, arm and wrist movements. More complex and advanced systems are needed to fully imitate the movements of a healthy person with a prosthesis. Prosthetics with sensors and actuators are good candidate robotic mechanisms to fully mimic human movements. Humanity has come to a point where more performance can be achieved than natural limbs with new generation robotic prostheses. Humanity is at a point where it can perform the act of feeling apart from actions such as walking, holding and lifting with prostheses [9–12].

2.5 Robotic nurses

Nurses are the worker bees of the healthcare system. It is almost inevitable to encounter at least one nurse next to the doctors in every hospital room where diagnosis and treatment is made. With the increase in life expectancy, older people inevitably spend their last days in hospital rooms or nursing homes. As a result, aging creates an increasing workload for nurses. It seems that robot nurses will come to the rescue of nurses who are overwhelmed by this workload. Robotic nurses can monitor and record vital signs, monitor the patient's condition and report the situation to the responsible health personnel. Robotic nurses are not only candidates to be the best friends of the elderly people, but also seem to be candidates for jobs of human nurses.

3. Conclusions

As a result of the rapid digitalization of the world, robots are also becoming more capable at an increasing rate. As the designs of medical robots are becoming more useful day by day, there is a significant decrease in costs compared to the past. As a result of the decrease in robot costs, robots are turning into candidates for the jobs of healthcare professionals. Although robots are increasingly taking their place in the healthcare system, the social consequences of this are not yet fully understood. If healthcare personnel will work less in the future, how healthcare personnel will spend their free time is a phenomenon that social scientists should consider in advance.

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