

Applications and future of robotics in life science

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Abstract- A robot is basically a programmable [machine](#) by computer capable of carrying out a complex series of actions automatically. The first robot was installed in 1974 in the automotive field. Since then, more than 150000 have been installed globally including a large proportion in the life science field. There are large numbers of applications of robotics in medical field which can be categorized on the basis of use of robotics. Robotics is used in medical field for robotic surgery, diagnosis, for providing artificial components to recover physical functions of human beings. Industrial robots are used in life science applications due to their advantages over human counterparts such as accuracy, reliability; provide better quality, more efficient etc. Research on robotics is very active today and in near future we can expect more advanced robots to be used in life science applications.

Keywords-Robotics, Life science application

I. INTRODUCTION

A robot is basically a programmable [machine](#) by computer capable of carrying out a complex series of actions automatically [1]. These can be guided by an external control device or the [control](#) may be embedded within. The first robot was installed in 1974 in the automotive field. Since then, more than 150000 have been installed globally including a large proportion in the life science field. Many of these early medical robots were only programmable liquid handlers that provided a mechanical arm for high-throughput screening (HTS) systems, where the arm moved samples from one instrument to another [2]. Research on robotics for medical applications started fifteen years ago and is very active today. There are large numbers of applications of robotics in medical field which can be categorized on the basis of use of robotics. First use of robot is for robotic surgery. Robotic surgery can accomplish what doctors can not because of precision and repeatability of robotic systems. The second use of robotics in medicine is diagnosis. Robotic diagnosis reduces invasiveness to the human body and improves the accuracy and scope of the diagnosis. The third use of robotics is for providing artificial components to recover physical functions of human beings such as robotic prosthetic legs, arms and hands [3]. Research on robotics is very active today and in near future we can expect more advanced robots to be used in life science applications.

II. COMMONLY KNOWN APPLICATIONS OF ROBOTICS IN LIFE SCIENCE FIELD

Da Vinci surgical system: Surgery is one of the fastest growing fields of robotics in health care. Surgical robots, the da Vinci Surgical System is stated using in 2000 in medical field. Using the daVinci system, operations can be done with the utmost precision, which means less bleeding, faster healing, and a reduced risk of infection.



Figure 1 da Vinci surgical system [6]

Endoscopy-Bot: An endoscopy is a procedure where a small camera or tool on a long wire is shoved into the body through a natural opening to a search for damage, foreign objects, or traces of disease. This is an uncomfortable procedure that might also be a thing of the past. With advancement in robotics endoscopy make use of flexible robots. Even more impressive are so called “capsule endoscopies” where a pill-sized robot swallowed that travels along your digestive tract gathering data and taking pictures that can be sent directly to a processor for diagnostics.

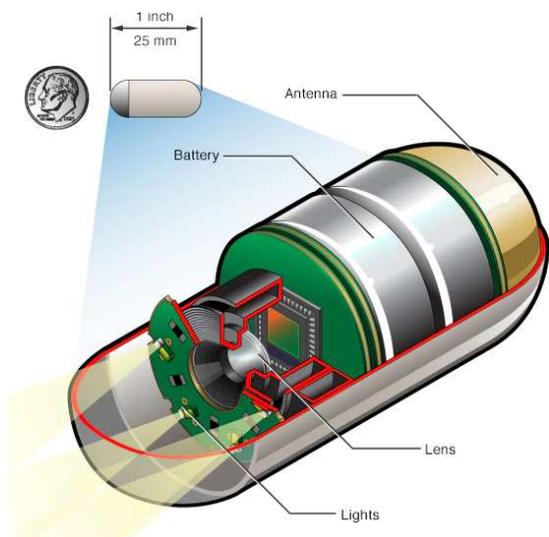


Figure 2 Capsule endoscopy [7]

Targeted therapy micro-robot: These are highly promising, though relatively new types of medical robots. These robots use near-microscopic mechanical particles to localize a drug or other therapy to a specific target site within the body [8].

Disinfectant bots: Modern disinfecting robots move autonomously to rooms of patients being discharged then release the high-powered UV rays in the empty room for several minutes until all microorganisms are dead.



Figure 3 Disinfectant robots [9]

Robotic nurses: These are systems that can fill out digital paperwork, take measurements of vital signs, and monitor a patient’s condition.

Robotic Assisted Biopsy: This is a potentially life-saving advancement led by a project called MURAB (MRI and Ultrasound Robotic Assisted Biopsy). It is a minimally invasive technique for early cancer diagnoses where a robotically steered transducer is guided to a biopsy site by a novel MRI/Ultrasound combination technique.

Antibacterial Nano robots: Antibacterial Nano robots are tiny machines made of gold nano wires and coated with

platelets and red blood cells that can actually clear bacterial infections directly from a patient’s blood.

Pharmacy robots: Robots can read information sent from hospital information systems and update the dispensing status of prescribed drugs back to the system. A robotic arm can attain the appropriate packet, collect and label the medication. In addition to scanning and using bar codes to verify medication, robots can also package, store and dispense filled prescriptions^[10].

Exoskeletons: These are wearable robots that can help humans with range of motion. They are used for rehabilitation therapy procedures, such as gait training to help patients with paralysis walk again and limb mobilization and guidance for patients recovering from a stroke^[10].

Tele robots: Human-sized tele robots feature audio, video and camera technology designed to facilitate patient monitoring, timely communication, specialized patient care and high quality emergency consultations. Robots enable clinicians to remotely log in, review patient data and communicate with the patient and other care team members. These robots can also send remote alerts to the care team based on the information they collect^[10].

III. ADVANTAGES AND DISADVANTAGES OF ROBOTS IN LIFE SCIENCE APPLICATIONS

1.1 Advantages

Accuracy: Robotic systems are more accurate than humans.

Reliability: Robots are more reliable as they can work 24 hours a day, seven days a week without stopping or tiring.

Affordability: With the advancements in technology and affordable robotic systems are available at less cost.

Quality: Robots have the capacity to improve product quality. Applications are performed with precision every time so these systems provide high quality of service.

Production: Because robots have the ability to work at a constant speed without pausing for breaks, sleep, vacations, they have the potential to produce more than a human worker.

Safety: Robots increase workplace safety. Workers are moved to supervisory roles, so they don’t have to perform dangerous applications.

Speed: Robots work efficiently, without wasting movement or time without breaks or hesitation; robots are able to alter productivity by increasing throughput.

Reduced chances of contamination: Removing people from the screening process reduces the potential for contamination and the potential for dropped samples when handling them in laboratories. Robotics performs these tasks much faster with more precision and accuracy^[2].

Increase Efficiency: Robotics can increase efficiency, which means the price of the drug itself will become more competitive. When it comes to pharmaceutical production, people are not as efficient as robots, especially when they are wearing a protective suit.

Can work continuously in any environment: Another advantage in the laboratory is that robots are impervious to many environments that would not be safe for humans. A robot can operate twenty-four hours a day, seven days a week in any environment.

1.2 Disadvantages

Dangers and fears: Although current robots are not believed to have developed to the stage where they pose any threat or danger to society, fears and concerns about robots have been repeatedly expressed in a wide range of books and films. The principal theme is the robots' intelligence and ability to act could exceed that of humans, that they could develop a conscience and a motivation to take over or destroy the human race.

Expense: The initial investment of robots is significant, especially when business owners are limiting their purchases to new robotic equipment.

Return on investment (ROI): Incorporating industrial robots does not guarantee results without planning, companies can have difficulty achieving their goals.

Expertise: Employees will require training for the new robotic equipment. This normally takes time and financial output.

Safety: Robots may protect workers from some hazards, but in the meantime, their very presence can create other safety problems.

IV. FUTURE OF ROBOTICS IN LIFE SCIENCE APPLICATIONS

Research in robotics field is very active today in medical field also. Advanced robots continue to be designed for a very important range of applications in the life science field. A research team led by Gregory Fischer, an associate professor of mechanical engineering and robotics engineering at Worcester Polytechnic Institute, is developing a compact, high-precision surgical robot that will operate within the bore of an [MRI scanner](#), as well as the electronic control systems and software that go with it, to improve prostate biopsy accuracy [11].

In other research, virtual reality is being integrated with robots to expand the range of therapy exercise, increasing motivation and physical treatment effects. Exciting discoveries are being made with nano particles and nonmaterials. For example, nano particles can traverse the "blood-brain barrier." In the future, nano devices can be loaded with "treatment payloads" of medicine that can be injected into the body and automatically guided to the precise target sites within the body. Soon, ingestible, broadband-enabled digital tools will be available that use wireless technology to help monitor internal reactions of medicines [11].

V. CONCLUSIONS

Robotic technology is still evolving. Today, robots are being designed to complement human skill sets, reduce workload and enable professionals to focus on more important activities that have a greater impact on patient care delivery due to their advantages over human counterparts like accuracy, reliability, speed, better quality, more efficient. As this technology advances and becomes more affordable, we can expect more health care institutions to embrace robotics.

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