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Robotics to Grow Sharply in Pharmaceutical Industry

Swati Yearimani*, Shilpa Bhilegaonkar, Hashweta Gawade, Yashodita Desai and Marfa Sheikh

Department of Pharmaceutics, P.E.S' Rajaram and Tarabai Bandekar college of Pharmacy, Farmagudi Ponda, Goa-403401, India

Abstract

Robotics has gained a worldwide attention in recent times especially in pharmaceutical industry. Robots are designed generally for the industrial use as the production takes place at larger scale in industries. These robotic products termed as 'Robots' are generally designed for industrial use playing a very important role right from packaging of medicines to research and development laboratories and for maintaining cleanliness as well. With the advancement in design and functioning of Robots, this field of technology has growing rapidly.

Keywords: Robotics • Screening • Technologies

Introduction

Insertion of technology in the field of science has helped a lot for well-being of humankind and 'Robot' is one of the examples. Robots are considered as an electro machine working on some sort of software programmes (virtual software agents known as bots) to simplify the tasks related to common day to day human activities. Robots became commercially viable in the early 1970 and were principally deployed in rugged and repetitive duties such as welding and handling in automotive manufacturing lines. Earlier, Robots were employed to perform activities like moving around, operate a mechanical arm, sense and manipulate their environment and exhibit intelligent behavior like mimicking humans or animals. Initially the industry was slow to adopt robots into manufacturing and packaging processes because of their industrial nature like large in size, apparently oily, machines associated with metal manufacturing processes etc. But in recent times the field of Robotics has seen a lot of advancement and has become a very important part of industries that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback and information processing. Additionally, the functioning of this technological invention in potentially hazardous settings in proximity to biological dangers, the threat of radioactive contamination and environment of toxic chemotherapy compounds has proved to be a boon to the science especially in laboratory, life science and pharmaceutical applications wherein robots perform tasks at rates beyond human capability. The first ASEA Brown Boveri (ABB) robot was known to be installed in 1974 in the automotive field and since then, more than 150000 have been installed globally including a large proportion in the pharmaceutical field [1]. The various aspects of Robotics in the field of Pharmaceutical industry are discussed in this article.

Literature Review

Robotics in pharma industry

Robots are manufactured according to their requirements for the specific task to be particular functioning. Here, the Pharmaceutical industry deals with medication which deals with filling and packaging of medicines, production of personalized medicines, in research and development laboratories and for maintaining cleanliness on daily basis.

Robots for filling, inspection and packaging: Robotics technology is being used for vial-filling application and transferring components from station to station via Robotics vial manipulation. The Electronic Speech Systems (ESS) Technologies Company also handles plastic and glass prefilled syringes in pre -process, buffering, and initial and end -of -line packaging. The primary advantage is creating sterile environmental which reduces the risk of contamination due to environmental conditions viz. humidity etc and contamination generated from human intervention during component transfer. In addition, productivity is increased because of the accuracy and efficiency of robots, which often perform at increased speeds and produce less scrap.

Automation inspection, as part of a robotic system, has the advantage of enabling 100% part inspection. Vision-sensing technology can be used in pharmaceutical packaging to verify serialization numbers for compliance with track -and -trace regulations. Robotics dexterity and accuracy combined with current and future optical technology and serialization software is the ideal technology for an automated solution, says langosch.

Robots for producing personalized medicines: Custom automation and contract -manufacturing company invetech recently partnered with Biopharmaceutical Company Argos therapeutics to develop automated manufacturing systems based on Argos Arcelis technology platform for personalized immunotherapies. The Arcelis platform uses two, five -axis robotic arms in the production of the MRNA from a patient's tumors, which is used as the antigen for loading into the dendritic cells produced in the cellular processing equipment, explains Richard Grant, director of cell therapy at invetech. The cellular equipment uses automation to manipulate the white blood cells throughout the manufacturing process to control their development and maturation into dendric cells. The cells express the desired antigens, which when delivered to a patient, will trigger the patient's immune system to produce killer T-cells that will target the metastatic tumors.

Cleanroom robots: Robotic technology is ideal for cleanroom processes, such as aseptic filling, because it eliminates human contamination risk. Robotics can provide an ISO 5 environment to preclude the possibility of microbial ingress, says Langosch. ESS technologies partners with Fanuc Robotics for secondary packaging and palletizing of pharmaceuticals, and Fanuc has several robots that will operate in an ISO 5 environment. The Fanuc M-430iA/2PV can withstand hydrogen peroxide vapor sterilization and has a waterproof rating; all wiring and cabling is routed through the robot's hollow arm.

Robots designed for use in cleanrooms must minimize particulate generation to maintain cleanroom classifications, typically ISO class 5 or 6. Cleanability, including minimizing crevices and ensuring the robots is resistant to cleaning and sterilizing agents, is also a requirement, notes Grant. Operator safety must be ensured by guarding or containing the robot.

***Address for Correspondence:** Swati Yearimani, Department of Pharmaceutics, P.E.S' Rajaram and Tarabai Bandekar college of Pharmacy, Farmagudi Ponda, Goa-403401, India; Tel: +9254734944; E-mail: swatiyearimani@gmail.com*

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Another requirement is controlling the speed of robot movement to minimize impact on airflow and particle generation and to a lesser extent, managing heat generation and its impact on the heating, ventilation, and air-conditioning system of the cleanroom, explains Grant.

Robots in the laboratory: Robotics has come a long way in the pharmaceutical laboratory; notes mike Ouren, life sciences manager at precise Automation. In the laboratory, robots are used for example to transport microtiter plates between instruments. “Although the instrument can be loaded manually, a robot tied to a scheduling software system eliminates human error, maintain the quality of the experiment, and allows scientist to focus on the content of the experiments, instead of how they will execute it, explains Oure.

Laboraties differ from industrial applications in that, although tasks are repetitive, they are not as consistent and may change depending on the experiments, says precise automation’s Ouren. The need to access equipment near the robot quickly and the space limitations of a laboratory can be met with new collaborative robots that do not require safety guarding. In the 2012, Precise Automation introduced a collaborative SCARA robot the PreciseFlex (PF) 400, which handles less than 1 kg loads and is designed to allow operators to work safely next to the robot without barriers. The smaller footprint of the robot reduces cost, and the space savings is useful in benchtop laboratory applications. The robot is user friendly, and the precise guidance controller inside the PF400 allows laboratory personnel to “teach” the robot using only their hands. “Because there are no barriers, instead of using a complex remote -control pendant to teach the robot, the operator can show the robot what to do by simply grasping the end of the robot arm. This accessibility is unheard of in industrial automation.”

Robotic pharmacies are expanding rapidly within the hospitals and clinics. Several companies are servicing that market and the interest level will only increase. On the retail level, robotics in local pharmacies will be a challenge. The technology is available but regulation will pace the growth of robotic pharmacies more than the technology. At the UCSF medical centre in California, such a system is already in place, and it is working wonders in terms of increasing efficiencies all around. Possibly the greatest benefit is the elimination of wrong dosage, wrong medication, and other errors largely contingent on human mistakes. Hospital pharmacies used to be centralized, but the model is increasingly opening up.

One problem, at least at this point, is that smaller hospitals do not have the capital at hand that’s necessary to account for the high upfront costs of installing such automated systems. However, there is a general shift toward that, which means costs will be going down in time.

Advantages of robotic automation of packaging

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

2. Flexibility: Robots can be easily reprogrammed based on packaging applications. Changes in their End of Arm Tooling (EOAT) developments and vision technology have expanded the application-specific abilities of packaging robots.

3. Savings: Automated packaging minimizes costs across the board. Not only is output increased, but robots are tireless. There are no labor expenses with robot packaging - no vacation or insurance costs to pay [2-4].

4. Tirelessness: A robot can perform a 96-man-hour project in 10 hours with more consistency and higher quality results.

5. Return on investment (ROI): There is quick turnaround with ROI. Plus, with the increase in quality and application speed, there are the benefits of increased production possibilities.

6. Accuracy: Robotic systems are more accurate and consistent than their human counterparts.

7. Reliability: Robots can work 24 hours a day, seven days a week without stopping or tiring.

8. Affordability: With the advancements in technology and affordable robotics becoming available at less cost, more pick and place robotic cells are being installed for automation applications [5].

9. Quality: Robots have the capacity to dramatically improve product quality. Applications are performed with precision and high repeatability every time. This level of consistency can be hard to achieve any other way.

10. Production: With robots, throughput speeds increase, which directly impacts 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.

11. Safety: Robots increase workplace safety. Workers are moved to supervisory roles, so they no longer have to perform dangerous applications in hazardous settings.

12. Savings: There are fewer healthcare and insurance concerns for employers, who will be working in safer environment which will lead to financial savings. Their movements are always exact, so less material is wasted [6].

13. Speed: Robots work efficiently and also offer untiring performance which saves valuable time. Without breaks or hesitation, robots are able to alter productivity by increasing throughput.

14. Flexibility: Robots are easily reprogrammed with packaging application; Changes in their End of Arm Tooling (EOAT) developments and vision technology have expanded the application-specific abilities of packaging robots.

15. Redeployment: The flexibility of robots is usually measured by their ability to handle multiple product changes over time, but they can also handle changes in product life cycles.

16. Smaller is better: The expenses of biological assays are high and getting higher. Robotics gives researchers the advantage of using tiny quantities of assays and to keep samples safe when moving them within the laboratory. 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.

17. Cost: Paybacks for the purchase of robotic equipment in the pharmaceutical industry, given the fairly high hourly labor rates paid to employees, number of production shifts, and the low cost of capital. A typical robot installation, complete with accessories, safety barriers, conveyors, and labor, could cost around $200,000. If that robot were to replace four manual workers each earning approximately $30,000 per year, the robot would be paid for through salary savings alone in a little more than a year and a half [7,8].

18. 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. People in protective suits also require more room to work in.

Disadvantages of industrial robots

1. 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.

2. Expense: The initial investment of robots is significant, especially when business owners are limiting their purchases to new robotic equipment. The cost of automation should be calculated in light of a business' greater financial budget. Regular maintenance needs can have a financial toll as well.

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

4. Expertise: Employees will require training in programming and interacting with the new robotic equipment. This normally takes time and financial output.

5. Safety: Robots may protect workers from some hazards, but in the meantime, their very presence can create other safety problems. These new dangers must be taken into consideration. The future of robots in pharmaceutical manufacturing: This range of vision applications in the pharmaceutical industry means it is one of the sectors with the most potential for growth in the entire field of robotics. Indeed, the scope of uses found for materials handling robots is only now beginning to become transparent. What is clear though is that the fundamentals of speed, payload and flexibility will continue to be important and that Toshiba Machine and TM Robotics will continue striving to offer industry leading machines that meet and surpass these requirements [9].

Applications of robots pharmaceutical industry

In the world of pharmaceuticals, there is a vital role for robotics to play in the complicated processes of research and development, production, and packaging. Justification for robots ranges from improved worker safety to improved quality. Speeding up the drug discovery process is another benefit of robotics. A number of robot manufacturers have products specifically designed for this industry [2].

1. Research and development (R&D): Robots now also play an essential role in the development of new drugs. In High Throughput Screening (H.T.S.) for instance, millions of compounds are tested to determine which could become new drugs. There is a need for the use of robotics to test these millions of compounds. The use of robotics can speed this process up significantly, just as they can any other process where a robot replaces a person completing any repetitive task.

2. Laboratory robotics: This new technology allows human talents to be concentrated on sample selection and submittal, and scrutiny of the resulting data, rather than monotous tasks that lead to boredom and mistakes. The desired results of this automation are of course better data and reduced costs. Using laboratory robotics, new experimental procedures are eliminating human tedium and miscalculation in washing and transferring. This includes experiments in radioactive, fluorescent, and luminescent analysis Laboratory robotics is being increasingly applied in pharmaceutical development to help meet the needs of increasing productivity, decreasing drug development time and reducing costs. Three of the most common geometries for laboratory robots are: Cartesian (three mutually perpendicular axes); cylindrical (parallel action arm pivoted about a central point); and anthropomorphic (multijointed, human-like configuration).

Control Systems Most robots have onboard controllers that communicate with other machines' Programmable Logic Controllers (PLCs) or with personal computers (PCs) networked to the line. Robot controller is an industrial VME bus controller that connects to PCs for networking and for graphical user interfaces.

4. Vision systems: A vision system provides a valuable tool for determining the accuracy of text and graphics in pharmaceutical and medical packaging. The chief benefit offered by adding a robot to the vision system is speed. It inspect insert in less than two minutes. The same inspection performed by one operator and checked by a second operator could take from 30 minutes to an hour.

5. Sterilization and Clean Rooms: Robotics can be adapted to work in aseptic environments. Clean room robots have features that protect the sterile environment from potential contamination. These features include lowflake coatings on the robotic arm, stainless steel fasteners, special seal materials, and enclosed cables. Clean room robots reduce costs by automating the inspection, picking and placing, or loading and unloading of process tools. Benefits of robot use in the clean room include:

- Robots reduce scrap by minimizing mishandled or dropped parts.
- Robots minimize scrap caused by contamination.
- Robots reduce the use of clean room consumables such as bunny suits.
- Robots reduce the amount of costly clean room space by eliminating aisles and access ways typically required for human clean room workers. Robots can also be enclosed in mini environments. This permits relaxed cleanliness throughout the remainder of the plant.
- Training costs and clean room protocol enforcement are minimized [10,11].

6. Flexible feeding: Robots are also better than hard automation at flexible feeding, a task that involves handling multiple types of products or packages whose orientation always varies. Traditionally, packaging lines have used high-speed, automated bowl feeders that vibrate parts and feed them to fillers, labelers, or product-transfer mechanisms. Bowl feeders, however, can't always handle a variety of products at once, and their vibration can damage fragile parts [12,13].

Conclusion

Robotics which has emerged as a newer and advanced field in pharmacy has gained much non popularity in pharma industry. Their applicability in different fields of pharma industry is appreciated. It is accepted that in future the robotics would play a vital role for the development and growth of pharmaceutical sciences.

Robotics has been present in the pharmaceutical industry for more than two decades. Once confined to clinical laboratories, the machines have found their way into the packaging processes and will continue to find new applications throughout the manufacturing arena. The future is always hard to predict, but it will be determined by technological developments, commercial factors and by changes within the pharmaceutical industry. What is certain is that robotic automation will continue to spread within the sector. Such are the commercial and financial pressures globally that, within a relatively short time, those who have failed to invest will struggle to compete. The future is always hard to predict, but it will be determined by technological developments, commercial factors and by changes within the pharmaceutical industry.

Since it is hardly feasible for end users to replace existing equipment to interface with robotics systems, manufacturers need to find a way to address this problem. The introduction of open architecture controllers expects to go a long way in reducing the impact of this challenge.

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