A To Z Applications of a Robot: A Study

Shrikrishan Yadav, Shailendra Singh, Dharmendra Dubey

Abstract*— Technology has been used to make nearly every aspect of our lives easier. In the future robot will play vital role in our daily life. There are many fields where a robot is ahead than the human in every manner. Robots are mainly used in industries as compare to other field. Factory mechanization is at present expected to improve productivity, quality and safety in the production industry, especially for functions depending on workers. By using robots in different types of technology such as sensing, measurement technology, control technology, mechanics technology, and to automate operations, the efficiency, reliability and performance can be increased of the system. Industry is one area where robots have typically been used over the years. Robots are the backbone of modern industries. Small companies are presently increasing their automation level to stay competitive. Typically, the service life of a robot is 15 years. Thus, making a onetime investment may help a firm to increase productivity as compare to human workers. In this paper we have discuss the different applications of a robot in different field of life.

***Index Terms*— Assembling, Education, Entertainment, High Power Lines, Highways, Industry, Railways.**

I. INTRODUCTION

The word robot was coined by a Czech novelist Karel Capek in a 1920 play titled Rossum's Universal Robots (RUR) [1]. The Robota in Czech is a word for worker or servant. In the past, factory production lines were automated for mass production, and many industrial robots and specialized machines were introduced. Recently, flexible manufacturing systems, such as the cell production system are being introduced in an increasing number of production sites in order to deal with differentiation of products and to meet diversified needs. However, many of the tasks in flexible manufacturing systems rely heavily on workers because the number of parts to be handled is larger so the time and costs required to switch product types on robots and specialized machines is greater. Recently, because of the decrease in the working population due to Japan's aging society with a falling birth rate, there are expectations that tasks which rely heavily on workers will be automated by using industrial robots in combination with sensing technology and production know-how. With "intelligence" as their motto, industrial equipment manufacturers are focusing on developing technology that will automate tasks that are currently performed by humans, but the types of tasks that have so far been automated are very limited.

II. ROBOT

A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks [1]. Robots can be autonomous, semi-autonomous or remotely controlled and range from humanoids such as ASIMO and TOPIO to Nano robots, 'swarm' robots and industrial robots. There are many ideal task of a robot some of them are very are dangerous such as space exploration, chemical spill cleanup, disarming bombs, disaster cleanup. Some of them are boring and/or repetitive such as welding car frames, part pick and place, manufacturing parts. Some task are required high precision or high speed such as electronics testing, surgery, precision machining.

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III. APPLICATION OF A ROBOT

There are different applications of robots in every field of life some of them are:

A. Assembling

Today robots are being used in industries for assembling various products, from mobile phones to wooden pallets to gas meters. Obviously accuracy is the key in many assembly applications and most robots are accurate to 0.1mm which is as good if not better than a human. Good examples of where robots can offer great advantages are those where the tool is heavy, noisy or dangerous. Assembly operations include: fixing, press-fitting, inserting, disassembling, etc. This category of robotic applications seems to have decreased over the last few years, even while other robotic applications have increased. It is 10% of the total work.

B. Handling

Robots have not only power and speed but also accuracy handiness and sensitivity. They are regularly used in a variety of industries for the manipulation of a excess of items from car doors to eggs, from springs to champagne. A typical large robot will be able to handle a load of 120kg at speeds of 2500 mm/s. Handling covers a very large range of applications. Handling can also include machine tending. Robots are excellent for working with injection moulding machines, blow moulders, CNC mills and lathes, spark eroders, presses etc. Material handling is the most popular application with 38% of operational stock of industrial robots worldwide.

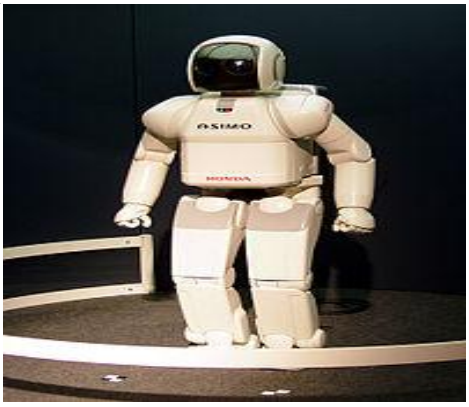

Fig 1: ASIMO (2000), A Humanoid Robot [1]

C. De-burring, Grinding, Polishing, Linishing and Finishing

By using the flexibility of 6-axis robots it is possible to

grind, trim, fettle, polish and even clean almost any part, in any material and achieve a consistent excellent finish. It is easy to use a multi-purpose tool to the end of the robot.

D. Cutting

Robots are the perfect tool for many cutting jobs. Laser, plasma and water jet cutters are often used with robots. Due to the dangerous nature of these technologies robots are the obvious choice. The excellent accuracy and path following capabilities give precise results time after time, in three dimensions and with greater flexibility than many dedicated cutting machines.

E. Palletising

Palletizing is a type of handling application. The principle is simple; the robot picks part or parts from one or more positions and the places them in sequence or in a particular manner. This is usually on a pallet, stacking for example bags of cement, in such a way that will stop the stack from easily falling over. This could also mean placing parts into a still age or other rack but the most important part is that the robot keeps count of the position to which it has gone and must go to next. Count functions were one of the first logic functions included in robot controllers and are probably one of the most used.

F. Welding

Welding robots can be very highly specialized: For example "poke welding" robots are spot welding robots that use the arm itself to generate the mechanical force needed. CO2 laser welding robots are fitted with a complex system of mirrors to take the laser to the end of the arm. This segment mostly includes spot welding and arc welding which is mainly used by the automotive industry. Spot welding is still more popular than arc welding but not for long; as arc welding is becoming very popular in the metal industry. It is 29% of the total work of a robot in an industry.

Fig 2: Articulated Welding Robots used in a Factory [1]

G. Sealing and Gluing

From an installation point of view sealing applications are very closely related to arc welding. The most important ability for the robot is to follow a path accurately with good control over speed. Robots are frequently used for sealing applications in the car industry using RTV to seal in windows, keep out water etc. There are two basic setups, either the sealant head is fixed or the robot moves the part or the part is fixed and the robot moves the sealant head. However any standard robot can be used for sealing it is just a matter of selecting the right reach and payload for the job

H. Spraying, Painting, Coating

Paint spraying was one of the first uses for industrial robots. The volatile and hazardous nature of solvent based paint means that it is best to minimise human contact and robots give an excellent and consistent finish. Painting robots have been developed that are solid to paint shop conditions and present no hazard when in proximity to flammable compounds or explosive atmospheres. Paint robots typically have quite thin arms as they do not have. Only 4% of the operational robots are doing administration.

I. Nuclear Wastage Cleaning/Handling

In nuclear reactor where human cannot use due to dangerous task than robots is used for different task such as cleaning the main circulating pump, collecting the wastage and operating some machines in the plant. In the nuclear industry, tele-operators have been well-utilized in the maintenance role for more than 4 decades. Tele-operators are playing main role in the maintenance of nuclear reactors.

J. Highways Maintenance

Robotic solutions to highway maintenance applications are attractive due to their potential for increasing the safety of the highway worker, reducing delays in traffic flow, increasing productivity, reducing labor costs, and increasing quality of the repairs. Applications areas to which robotics can be applied in this area include:

1) Crack sealing, pothole repair
2) Pavement marker replacement, paint re-striping
3) Litter bag pickup, on road refuse collection, hazardous spill cleanup, snow removal
4) Sign and guide marker washing, roadway advisory
5) Vegetation control, irrigation control
6) Automatic warning system, lightweight movable barriers, automatic cone placement and retrieval

For example, some this type of technology is used in the new highway construction of Jaypee group i.e. “Yamuna Express Way”, the best highway of India ever from Greater Noida to Agra (Uttar Pradesh).

K. Processing

Processing is not a big segment of industrial robots and this is probably because a lot of automated machines are available on the market to do specifically these applications. The main application areas are mechanical, laser and water jet cutting. It is the only 2% of the total work of a robot in the industry.

L. Maintenance

Maintenance is the process that preserves or restores a desired state of a system or facility. The maintenance process includes three major activities: inspection, planned maintenance, and disturbance handling

M. Power Line Maintenance

Many common maintenance operations on overhead transmission lines are performed by human operators on live lines. Examples of these tasks include replacing ceramic insulators that support conductor wire and opening and reclosing the circuit between poles. These tasks are very dangerous for the human workers, due to risks from falling from high places and the risk of electric shock. Obtaining skilled workers to perform these tasks is quite difficult due to the high training and labour requirements of the job. Performing the maintenance while the lines are de-energized would recover some of the risks, but would also create other problems with a society that demands interruption-free service from electric power companies. So robots can be used in place of skilled workers to remove these types of problems

and provide interruption-free service.

N. Aircraft Servicing

Aircraft servicing applications may benefit from robotic maintenance in several areas. The size of modern multi-engine jets makes inspection and coating removal and application particularly attractive in terms of improving quality and efficiency. Automated stripping and painting systems are already in place at a few U.S. Air Force bases. A robotic assistant for re-arming tactical fighter aircraft is being developed at the Oak Ridge National Laboratory for the U.S. Air Force.

O. Railways Line Maintenance

The rail industry has recognized the economic benefits of automation, which has lead to the development of a number of robotic solutions to maintenance and repair applications in the industry. The railway maintenance shops are the most common location of robots, which perform activities such as welding, grinding, cleaning, and painting. An integrated onboard computer system is used to generate onboard grinder controls for finishing the rail to the appropriate, pre-determined rail contour. There for rail accidents can be control or stop mainly due to breakage or crack of railway track.

P. Underwater Facilities

Similar to nuclear power plant tele-operated robots are widely used to maintain facilities under the surface of the ocean, mainly in service of the offshore oil industry where human workers cannot use. Specific applications include repairing communications cables, pipelines, well heads, and platforms. Tele-operators have also been deployed to clean marine growth from power plant cooling systems, to inspect and clean steam generators, perform underwater construction, and to inspect and repair water conveyance tunnels.

Q. Pick and Place

Robotics is used in different operations of maintenance, repair, picking, moving, handling etc. Very large machines are operated by the robots in an industry. The pick and place robot such as the ABB IRB 340 are designed specifically for very fast and accurate work often coupled to a vision system. They are often used in the food industry for jobs such as picking chocolates from a moving conveyor and placing them into boxes in given positions at speeds of over 150 picks per minute.

Fig: 3 A Pick and Place Robot in a Factory [1]

R. Coke Ovens Maintenance

A robot developed by Sumitomo Metal Industries, Ltd., Japan, for repairing the chamber wall of a coke oven. Damages to coke ovens occur over years of operations due to repeated cycles of chamber door opening and coke pushing, which induce damaging changes in temperature. The result is cracks, joint separations, and chamber wall abrasion, which can lead to gas leakage, air pollution, and structural flaws in the ovens. Thus, the effective repair of coke ovens is needed to extend the life of the ovens and to allow for stable operation. Especially challenging maintenance operations involve the repair of the central portion of the oven. This type of repair is very difficult due to the inaccessibility of the area, the high temperature, and the large number of narrow cracks. Any technology for repair in this area must involve high heat resistance components and mechanisms for external observation, resulting in repairs of high quality and durability. Of special benefit to the industry is the ability to perform these repairs without disturbing oven operation or incurring a large firebrick temperature drop.

S. Entertainment

Pole dancing robots, some robots are used for entertainment and as an exhibition of the newest technology. Some robots are playing games and some are playing with musical instruments and making some good rhythm.

Fig: 4 TOPIO, A Humanoid Robot, Played Ping Pong [1]

T. Inaccessible task

There are many jobs which humans would rather leave to robots. The job may be boring, such as domestic cleaning, or dangerous, such as exploring inside a volcano. Other jobs are physically inaccessible, such as exploring another planet, cleaning the inside of a long pipe, or performing laparoscopic surgery.

U. Military

Robots have found wide applications in modern day military. It become the main component of every machine or vehicle which are used mostly in war or in critical conditions. Military robots include the SWORDS robot which is currently used in ground-based combat. It can use a variety of weapons and there is some discussion of giving it some degree of autonomy in battleground situations. Robots are also used by military/civil defence to defuse roadside bombs/explosives.

V. Medical

In these days, robots play a major role in the field of medicine. Robots can be helpful in the medical world by three ways which includes dealing with diagnosis, surgery and bringing back good health for the patients. There seems to be high risk of difficulties in most of the surgeries and sometimes there are chances for humanity. Hence, most of the scientists

and doctors made various researches in order to make the surgeries safe and secure. In such situations, robots can help a lot in making the surgery safer since they could make smaller cuts in the organs or tissues. This would in turn make the patients feel easier and comfortable.

The most important point considered in the medical world is to get accurate and safer diagnosis. Most of the times, the patients are diagnosed in an inaccurate manner and hence they suffer from various problems. The test instruments in robots are able to perform various tests that can be performed by doctors or nurses. These tests include sample collection, CAT scans performance, etc. This would help in reducing the errors and also reduces the malpractices done in case of reports delivered.

The use of robots in medicine is growing as the technology has proven to be more useful in a number of applications. More and more technical advances are being made that will produce more sophisticated robots and lead to even greater diagnosis and treatment protocols.

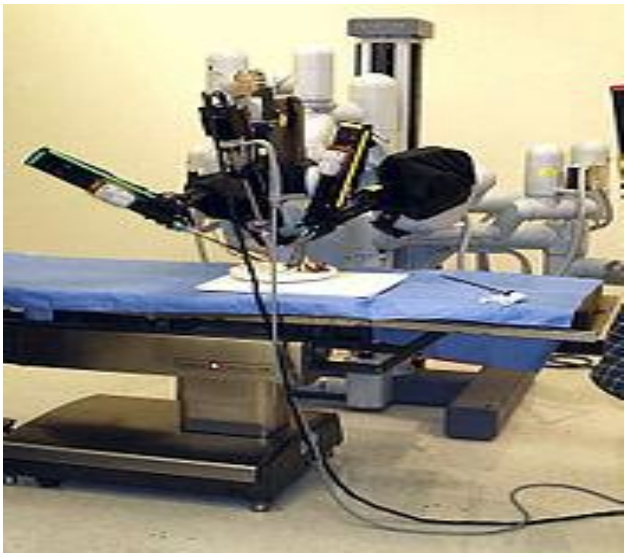

Fig: 5 A Laparoscopic Robotic Surgery Machines

W. Agriculture

Agricultural robotics is the use of automation in bio-systems such as agriculture, forestry, and fisheries. Applying automation to agriculture has helped create several advancements to the industry while helping farmers save money and time. These are capable of collecting crop and soil samples because they are small in size, which allows them to be able to accumulate data close to the crops. They are also capable of mowing, spraying pesticides, finding diseases or parasites, and performing mechanical weeding. These are equipped with cameras and sensors that are used to detect weeds and other forms of stress. Their sensors are used to spray only the area affected by the parasite instead of the entire crop. This has helped to protect our environment by reducing the amount of harmful chemicals released in the air. AgBo is an agricultural robot developed by Yoshi Nagasaka.

X. Education

Robotics teaches skills for every field of interest from the arts to zoology. Robots are currently used to test medical students. Robots are especially useful when training new doctors and teaching surgical methodologies. The Pregnant Robot, for example, can simulate the birth of a child. Many other robots are available to teach other methods without allowing inexperienced students to make mistakes in actual clinical settings.

Educational robots are used by every level of student. Kits are geared to various age and skill levels. Robotics competitions are being held for every age level in colleges or universities. Students do not yet receive formal education on robots and are more likely to enter competitions as clubs competing against each other representing different educational institutions. Robotics at school in the 21st century has three main applications, Robotic kits, Virtual tutors, and teacher's assistants.

Y. Domestic Use

Domestic robots are simple robots dedicated to a single task work in home use. They are used in simple but unwanted jobs, such as vacuum cleaning and floor washing, and lawn mowing. Some robots are used for different kitchen works and security. By just pressing the button a human can do everything in their home? Humanoid robots and innovative shaped robots are evolving a place in homes and offices, providing information and communications, as well as automated locomotion.

Fig 6: The Roomba domestic vacuum cleaner robot does a single, menial job [1]

Z. Research

While most robots today are installed in factories or homes, performing labour or life saving jobs, many new types of robot are being developed in different laboratories for different purposes around the world. Much of the research in robotics focuses not on specific industrial tasks, but on investigations into new types of robot, alternative ways to think about or design robots, and new ways to manufacture them. It is expected that these new types of robot will be able to solve real world problems when they are finally realized.

IV. CONCLUSION

Roughly half of all the robots in the world are in Asia, 32% in Europe, and 16% in North America, 1% in Australia and 1% in Africa. 40% of all the robots in the world are in Japan, making Japan the country with the highest number of robots. In year 2010 the estimated sales of robots in Japanese market was 1.8 trillion yen and in 2025 it can be 6.2 trillion yen. So it can be estimated that in future the robots will become an important part of our life. The Honda Company manufactured male and female HUMANOID (Human Robot). Among the European countries, Germany is the leading user of industrial robots.

One may think it is surprising that labour surplus

economies like China, Taiwan and Korea are going ahead in using robots for industrial production. The primary reason is that robots help in improving productivity significantly and secondly there are some sectors where humans are no match for robots. With regard to sectoral application of robots, the robots have maximum application in motor vehicles sector followed by electrical/electronic sector. According to the market forecast, the sectoral application of use would be more or less same barring that automotive parts sector would overtake electrical/electronics sector in use of robots.

India is slow in adopting robots in industry. Whatever little adoption has happened is in the automobile sector and that too due to green-field foreign direct investment. What is more, industrial robots were not classified as a separate entity prior to National Industrial Classification 2008 (NIC-08). It is mostly likely that this probably does not reflect the industrial robot segment.

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REFERENCES

[1] www.wikipedia.org\robots.html.
[2] Handbook of Industrial Robotics, 2nd Edition, edited by Shimon Nof, 1998
[3] Idustrial robots by Sanjib Pohit
[4] Ravani, B., and West, T. (1991). Applications of Robotics and Automation in Highway Maintenance Operations. In Proceedings of 2nd International Conference on Applications of Advanced Technologies in Transportation Engineering (pp. 61-65)
[5] Anonymous (1986). Toward the 'smart' rail maintenance system. *Railway Tract. Struct.*, 82 (11), pp 21-24.
[6] Ali, M., Puffer, R., and Roman, H. (1994). Evaluation of a multifingered robot hand for nuclear power plant operations and maintenance tasks (pp. MS94-217-1-10). Proceedings of the 5th World Conference on Robotics Research. Dearborn, MI: Robotics International of the Society of Manufacturing Engineers.
[7] Aracil, R., Penin, L., Ferre, M., Jimenez, L., Barrientos, A., Santamaria, A., Martinez, P., and Tudun, A. (1995). ROBTET: A New Teleoperated System for Live-Line Maintenance. Proceedings of the 7th International Conference on Transmission and Distribution Construction and Live Line Maintenance, Columbus, Ohio, pp 205-211.
[8] Birch, S. and Trego, L. E. (1995). Aircraft stripping and painting. Aerospace Engineering, 15, pp. 21-23.
[9] Dunlap, J. (1986). Robotic Maintenance of Overhead Transmission Lines. IEEE Transactions on Power Delivery, PWRD-1 (3), pp 280-284.
[10] Edahiro, K. (1985). Development of "underwater robot" cleaner for marine live growth in power station. In *Teleoperated Robotics in Hostile Environments*, by H. L. Martin and D. P. Kuban (eds.), (Robotics International of the Society of Manufacturing Engineers, Dearborn, MI), pp. 108-118.
[11] Najafi, F. T., and Naik, S.m. (1989). Potential Applications of Robotics in Transportation Engineering. *Transportation Research Record*, 1234, 64-73.

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