



## A Review on Service Robots - Game Changers of the Capricious World

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**Abstract--Service robot is one popular field in robotics where most recent researches are taking place. These service robots perform tasks that previously done by humans and tasks that are hazardous to humans. These robots are apart from industrial uses and are mostly used for addressing and helping people. There are many successfully developed service robots and ongoing researches to develop its design, software, hardware, and functionalities. This review-paper contains all information of service robots looking from different aspects and discussed about some of the existing service robots.**

## I. INTRODUCTION

Service robots are machines that occasionally work in place of humans to do predetermined tasks in a socially interactive or non-interactive manner but are not designed for use in an industrial setting. The area of application is what distinguishes industrial robots from service robots [1].

Artificial intelligence enables these robots to respond to a real time scenario instantly. By gathering vast volume of data, these robots continue to innovate. Service robots help mankind in day-to-day life by boosting productivity, improving efficiency, accuracy and by minimising staffing costs. The automation of exhaustive and hazardous jobs like cleaning the windows of Burj Khalifa has been proven successful and effective with a constant quality level.

This report places a strong emphasis on the widespread use of service robots. It analyses the current state of service robots in the major domains. This study brings forth a comprehensive look at the significance of service robots.

## II. HOSPITALITY ROBOTS

In this current world, robots have started to step into every field and industry that has ever existed [2]. A more recent concept is the use of robots in hotel management. Fig.1 depicts the image of a hospitality robot. Robots are used in hotels and restaurants for a variety of reasons. From a cost perspective, using robots to provide hospitality and serve food in hotels is becoming more affordable. Robotic staffing in everything from huge eateries and inns to small boutique hotels has increased significantly. However, this cannot be done without the availability of reliable wireless and internet connectivity, cellphones, and affordable on-time services from service centers. Robots can perform whatever task a man can, but they can only do it to a limited extent. However, it still has a lot of benefits, making it a wonderful choice.

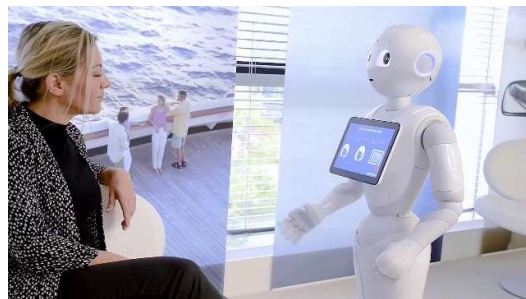


Fig.1 Hospitality Robot [3]

Some of the real-time examples of robots used in hotels are listed below.

### A. Robots intended to Greet Guests

These robots are sometimes referred to as “Guest Ambassadors”. These robots can understand people, assist them in determining their current location, the location of elevators, routes to specific rooms, and provide simple answers to questions. The humanoid look gives off a kind vibe to the public, and when staff members can't attend to customers right away, these robots can take care of the needy.

### *B. Housekeeping Robots*

Housekeeping is an important concern of implementing robots in restaurants. There are housekeeping robots which have been designed to carry out several services. It is important to disinfect the room once the guests check out. This can be done with the help of robots instead of humans. This has become an important concern due to the recent COVID-19 and this has helped in reducing the percentage of direct contact with affected people during the times of post COVID-19.

There is another robot design which focuses upon generalised services like providing bins of fresh linen to the appropriate floor. This resulted in providing clean towels and sheets and has resulted in an increase in overall satisfaction of the guests. The floor cleaning is the quite popular one. Once the guests check out a room, it enters the room and cleans the floor to make the environment clean for the new guests. These are also used in hotels and domestic sectors.

#### *1. Room service Robots*

There are robots which are designed to provide bespoke room service options to guests. These robots will supply food to rooms from the hotel kitchen and ensures that all meals are fresh. The guests can order needy from the room so that they no need to leave the premises and enjoy the food in their room.

#### *2. Waiter Robots*

In recent days, hotels use robots as waiter instead of human waiters. They are provided with small tracks to move from kitchen to the respected tables while the customers can move freely around the hotel. They are capable of both taking up order and delivering it to the respective room or table. This can result in reducing labour cost while ensuring the satisfaction of customers are met.

#### *3. Cooking Robots*

Cooking robots are the most interesting concept. They are not only programmed to cook complex dishes, but also to maintain the accuracy of taste. Moreover, these robots are used to prepare bulk meals in a timely fashion. These robots also ensure clean and hygienic production of food and ensures that the quality of food is met.

The Sheraton Los Angeles San Gabriel Hotel has implemented a smart automated robot to carry guests' luggage. These robots are placed in strategic positions to cater the need of the guest and to carry their luggage.

These robots are designed to greet new arrivals, luggage handling, leading guests to specific destinations within the hotels, and offering room service. During peak vacation seasons, these robots proved to be a great asset to the hotel management.

Alibaba's Fly Zoo Hotel has been named as the “Hotel of the Future” because as it implements many robots in their premises. These are centred around a bespoke mobile application, common issues such as checking in and access via facial recognition have been dramatically streamlined using Artificial Intelligence. Voice-activated bots along with autonomous smart machines delivers the needy service to the guest.

One of the main advantages is that these robots can free up staff members and workers so that they can address the guests. Moreover, these hotel robots perform task around-the-clock that might be impossible for the employees to achieve. Many requirements of the guests can be full-filled with a higher level of precision when compared to human counterparts. The presence of robots provides the hotel a cutting-edge appeal.

Thought there are a lot of advantages, there are also a handful of disadvantages. Some tasks such as addressing a question which are not pre-programmed will need to be addressed by a human. Another disadvantage is that some guests still wish to enjoy the human touch during their stay. Even though there are many advanced robots, they lack the human feeling. Simply, majority of the robots are incapable of providing a truly personal touch that a human staff can provide.

## III. MEDICAL ROBOTS

Surgeries are done to living beings when the condition of their health is very critical or when they are about to die. So, in that case, a doctor must do their surgeries very carefully and with their full determination in their work without thinking of their family, relatives, friends, etc., and for many hours they need to do their work continuously. For that purpose, if we introduce a robot, the doctor can make use of it [4].

Robotic surgery or surgical robots, which can do surgeries with doctors, is also called robot-assisted surgery. Fig.2 depicts the image of a surgical robot. It allows doctors to do many difficult surgeries with more precision, flexibility, and control and can save the lives of many very easily compared to doing them by hand. It can also be helpful to do many surgeries at a time due to the availability of more doctors and surgery robots, so that many lives can be saved. In robotic surgery, procedures are programmed to perform surgery through tiny incisions, so that the operations are done accurately. This type of robots can be used in various surgeries like

Heart Surgery, General Surgery, Gynecologic Surgery, Thoracic Surgery, Urologic Surgery.



Fig.2 Surgical Robots [5]

These are the surgeries that can be performed by robotic surgery, and these surgeries can be performed only when the doctors or surgeons learn how to handle these robots perfectly without any single mistake happening. And the surgeon must be very careful and be cautious while using those robots. The technologies used in surgical robots are:

- Surgical arms with tiny instruments and wrists at the tip of the robot's arms to perform surgery in the body of the living being. Generally, surgical robots have 6 degrees of freedom (DOF) [6]. 4 DOF for the arm outside and 2 for the wrist tip. The surgical instrument was carried by the robot arm. The robotic arm is used to do the surgery on the patient's body.
- A camera to show the 3-D view of the body of that living to the surgeon very clearly, so that the surgeon can see it easily while operating the robot.
- Surgical console is a device where the surgeon can control the robot to do the surgery and the surgeon can see the camera for every move of the robot arm. The surgeon can control the robot by using this. It gives the surgeon a highly-defined, magnified, 3-D view of the body.

The techniques in both open surgery and robotic surgery are the same, but the difference is how the surgeon does the surgery. Like in open surgery, the surgeon will do the work with a large incision, but in robotic surgery, the robot will do the work with a small incision and the surgeon will operate the robot. And the other difference is that the instruments need less space to do the surgery.

The advantages of using surgical robots are that the arm movements of the robots are more precise than a human hand and the range of motion is greater. The error that a robot can make is 2.04%, which is much less than the normal surgeon makes [7]. The arms of robots can handle the instruments very tightly and more carefully than human surgeons do. The robots can see through cameras, which is clearer than the naked eyes of humans, so that surgeries can be done easily. The

surgeries can be done inside the body by allowing only small instruments inside that body so that there are only small incisions. The pain will be lessened during recovery. The risk of infection will be lower. The loss of blood will be reduced during surgery. The number of stays in hospitals would be less as the surgery done by robots takes less time than the surgery done by surgeons, so we can recover easily.

#### IV. SOCIAL ROBOTS

Nowadays, all people are going very deep into technology, so we cannot speak with others or take care of ourselves at a certain stage of age (above 60 years) mostly. In the older days, people could overcome many problems, but now the situation is not the same, so to interact with people, to take care of people, and to help people in many ways a new type of robot has been introduced to the world, which is named social robots. A social robot is a physical embodiment of some synthetic materials are designed with a screen to represent their faces, with which they can dynamically communicate with others [8].

As the name implies, social robots assist people and perform charitable acts. Fig.3 depicts the image of the social robot This type of social robot is designed to interact with humans and other robots. This type of robot has the potential to do entire job functions in the work place. It can also do greetings and customer service. But in the home, it can act as a normal family member and do the household work as we do, and it can act according to human personalities as it is programmed with artificial intelligence (AI). Some of the social robots are hitch BOT, Kismet, Tico, Bandit, Jibo. Numerous studies have found that these robots are a great fit to teach children with autism social skills and emotional intelligence [9]. Normally, children with autism think of a robot as less intimidating than a living being. These robots interact independently of the things in the environment on their own due to the AI system programmed in them. This is an autonomous robot. The social robot is also called a smart robot. Smart robot intelligence is typically based on cognitive computing models that simulate the human thought process and which lead the robot to take a reaction to that process. This type of cognitive computing involves machine learning (ML) systems, which use data mining, pattern recognition, and natural language processing (NLP) to mimic the workings of the human brain. These are the programmes used in these robots to make the robots interact with humans. The social robots are used in many ways like 1)tutoring the children which means it will teach the children in a fun and interactive ways even better than a master does and make the children to learn the new skills, 2)Telepresence which means that it will arrange the meeting for many persons staying in different places to meet like a physical meeting, 3)Companionship which means that it will give company to the peoples according to their mental mood, 4)Customer Engagement which means that it provides

all the necessary details to the customers like the salesman does like saying about the product's features, specifications, price, availability, etc., 5)Elderly Care which means that it will take care of the patients in the hospitals or the elders to say the timings of snack, sleep and make them to do it at the perfect timing [10].

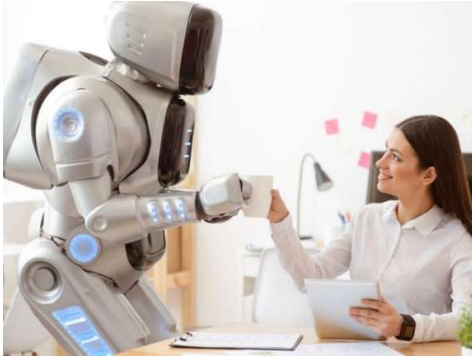


Fig. 3 Social Robots [11]

These types of robots are friendlier towards humans. It can also be used in long-term care environments to provide social interactions and monitoring for a particular purpose for these robots. The social robots are used in the medical field by encouraging patients to take treatment with specific rules given by surgeons or by providing cognitive engagement to the patients, and it helps to keep the patients positive and alert. These types of social robots can also help the people in the hospital by taking them to any of the directions they want inside the hospital, so that the people can go anywhere around the hospital easily within a short span of time and without any sense of wrong direction in mind. Social robots also help the patients to reduce stress and mental health problems, give companionship for emotional well-being, and reduce caregiver workloads as they take care of the patients. During COVID times, these types of social robots play a major role in offering medicine to patients and taking care of them in a contactless manner. It greatly helped in controlling the spread of the COVID-19 virus.

## V. CLEANING ROBOTS

Instead of placing our waste in the trash can, we humans scatter it all over the area. Therefore, there is more rubbish in the usual spots. which makes the cleaner or sweeper's work difficult. Cleaners cannot clean all trash for more hours, so instead of humans working there, if we introduce robots there, the task of cleaning will be completed easily. Nowadays, technologies are increasing rapidly, which makes humans' work easier and within a short span of time. The robots' cleaning will be easier and they will complete the work within a short span of time. As a result, humans developed cleaning robots. Fig.4 depicts the image of the cleaning robot.



Fig. 4 Cleaning Robots [12]

The robots introduced for this purpose are called cleaning robots. These robots are used in various places in the world only for cleaning purposes in different places. These types of cleaning robots are categorised as home cleaning robots, garden cleaning robots, bathroom cleaning robots, skyscraper cleaning robots, etc.,

### A. Home Cleaning Robots

These robots are also called robotic vacuum cleaners. They were first patented and worked on in 2005. They navigate themselves; they automatically dump the dust and even return to the charging station to recharge themselves and make the cleaning easier for themselves, which feels like magic as it cleans very thoroughly in a short span of time [13].

They use plastic chassis, and they can also go through tight spaces. They use lithium-ion batteries, and some of them have a run time of 120 minutes. They use one or two spinning brushes along with a rolling brush for cleaning. These brushes collect the dust towards the electric motor suction and this dust can be removed from the suction after cleaning. Some of them have a HEPA (High Efficiency Portable Air) filter as well. By this feature, they are very effective in cleaning dust particles.

These robots navigate automatically using obstacle and cliff sensors. These sensors are located on the robot's bumper, and these sensors make the robot avoid distractions. As the bumper insists, the robot moves accordingly. They even use lasers for dark places. One of the most famous home cleaning robots is the Roomba 976.

### B. Garden Cleaning Robots

A garden is a very important thing for many people, but most elderly people cannot take care of their gardens, so they are hiring people for gardening work [14]. Instead, a robot can do that job perfectly. This robot is equipped with a camera, LED, leaf blower, and three nozzles to spray the water. This robot can also spot the plants that need water and spray water on them. If the robot is lost, then the owner can be able to find it through a GPS unit, and this robot can defend itself and the owner also. It has a water tank capacity. If the water



is empty in the tank, it has a special solar-powered valve which makes the robot refill the water tank, and the users can also refill the pesticides and herbicides in the separate tank which is stocked manually. It can take care of the gardens very carefully.

### C. Bathroom Cleaning Robots

Nowadays, humans are not cleaning their toilet properly, so along comes a toilet cleaning robot to clean the toilets properly. This robot is used for cleaning bathrooms or lavatories. Its use nowadays is increasing rapidly. This robot cleans the toilet with hygienic standards and has a line follower mechanism to guide the robot, and an RFID module to perform the operation of auto flushing, which makes the cleaning operation fully automated and requires low power. The robotic arm will clean the toilet bowl. The components used in this type of robot are DC motor, frame, shaft, worm and worm gear arrangement, limit switch, bearing, metal strip, toilet cleaning brush. The robot rotates only with the help of a motor. The horizontal movement is limited with a limit switch. Then the brush and mob clean the toilet bowl [15].

### D. Skyscraper's Wall Cleaning Robots

Cleaning the windows of tall skyscrapers is the most dangerous job, it is not safe for human to work at such high heights. A robot is needed to clean at such heights; so a new robot called the skyscraper wall cleaning robot is introduced. A system called the Automatic Skyscraper Wall Cleaning System (ASWCS) does a risk-free and automated cleaning of the walls of high buildings. It moves on a roller-based platform and is suspended by a pulley from the top of the building. The motor is used in this robot to do the cleaning, and it also has a cleaning water brush and a water spraying system. This robot has a microcontroller processor TI MSP430, which makes it possible for the robot to perform cleaning in the high-rise building. At first, it will calculate the dimensions of the building as an input and then start to do its work [16]. There are many types of cleaning robots, excluding these types. These cleaning robots make it easier to clean all places in our environment.

## VI. SURVEILLANCE AND SECURITY

One of the primary security techniques used to safeguard assets and occasionally even individuals is surveillance. It is the full-time work of security professionals to monitor and patrol big regions, which is tedious and considerably more difficult. A sleepless night's work is surveillance. As a result, mistakes are more likely to happen. There are some places, like pastures and agricultural areas, that only need to be watched after for a certain amount of time [17]. In areas of civilians, patrolling streets all night by police is a hardened thing to do. Areas affected by toxic substances or gases cannot be checked or analyses by humans. High

voltage installation and high stream pipe conditioning are few other fields which requires alternates to humans.

These kinds of problems require a modern solution and that's where the emergence of robots seems quite significant. Autonomous security robots are capable of patrolling complex environments and detecting anomalies in the environment through sensors and cameras. For the agricultural sector, mobile surveillance robots are the cost efficient and powerful solution instead of installing a temporary surveillance station. These robots can navigate through complicated environment using satellite navigation and obstacle detecting algorithms. Fig.5 depicts the image of the surveillance robot.



Fig.5 Surveillance Robots [18]

Robots like SPOT (capable of monitoring radiation levels, checking for hazardous gases, predicting seismic changes), Knightscope's robots (capable of patrolling streets in accordance with police) have proven to be the effective alternates [19]. The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) have developed a robot with video-guided manipulator to diffuse and dispose bombs [20].

The surveillance robots in the agricultural sector are outfitted with a PTZ camera and a panoramic video surveillance system to follow motion at a distance. Additionally, a 360-degree camera is utilised for motion tracking. These security and surveillance robots are equipped with computer vision to recognise people and read metre figurers. In order to adapt to changing circumstances, security robots are developed with self-driving capabilities and infrared cameras (night vision).

Accomplishment of robots in these domains have greatly reduced the capital required since this is a onetime installation process. Surveillance and security robots can work 24/7 without any problem. With the help of Patrol Robots, we can easily avoid intruders. Highly dangerous jobs like diffusing bombs can be carried out without any harm. Security robots also plays a vital role in frontline defences.

## VII. CONCLUSION

Utilisation of robots as service robots has given light to various solutions. Service robots have provided way more effective and cost-efficient solution to real-life

problems. They seemed to be the best possible way of treating infected people during the covid pandemic, yet lot more advancement was required. Accomplishment of robots have reduced the exposure of humans to highly hazardous environments. People have started to adopt the rapidly changing world of technologies in which functioning without these robots is quite impossible. Introduction of robots in surgeries have reduced pain and blood loss, minimalised incisions, etc., Robot surgeries

allowed the surgeons to operate with extreme accuracy even with complex surgeries [21].

This paper has comprehended the current status and progress in service robots. This study has attempted to visualise the extend of service robots in various fields. As a conclusion, it can be realised that Service robots' scope in future is going to increase drastically and which will further help the mankind to progress smoothly.

## Reference:

- [1] Bakri MQ, Ismail AH, Hashim MS, Safar MJ. A review on service robots: Mechanical design and localization system. In IOP Conference Series: Materials Science and Engineering 2019 Nov 1 (Vol. 705, No. 1, p. 012003). IOP Publishing.
- [2] Lee I. Service robots: a systematic literature review. Electronics. 2021 Oct 30;10(21):2658.
- [3] <https://images.app.goo.gl/TmprjUxZrZ869cicA>
- [4] <https://www.revfine.com/hotel-robots/>
- [5] <https://robots.ieee.org/robots/davinci/>
- [6] <https://www.techtarget.com/searchenterpriseai/definition/social-robot>
- [7] <https://my.clevelandclinic.org/health/treatments/22178-robotic-surgery>
- [8] <https://www.intel.in/content/www/in/en/healthcare-it/robotics-in-healthcare.html#:~:text=Social%20robots%20interact%20directly%20with,keep%20patients%20alert%20and%20positive.>
- [9] Rajih E, Tholomier C, Cormier B, Samouëlian V, Warkus T, Liberman M, Widmer H, Lattouf JB, Alenizi AM, Meskawi M, Valdivieso R. Error reporting from the da Vinci surgical system in robotic surgery: A Canadian multispecialty experience at a single academic centre. Canadian Urological Association Journal. 2017 May;11(5):E197.
- [10] Rajih E, Tholomier C, Cormier B, Samouëlian V, Warkus T, Liberman M, Widmer H, Lattouf JB, Alenizi AM, Meskawi M, Valdivieso R. Error reporting from the da Vinci surgical system in robotic surgery: A Canadian multispecialty experience at a single academic centre. Canadian Urological Association Journal. 2017 May;11(5):E197.
- [11] <https://images.app.goo.gl/R4KJ3X46mCawgSLw8>
- [12] <https://images.app.goo.gl/zfFbVPLkocKGoY688>
- [13] [https://en.m.wikipedia.org/wiki/Social\\_robot](https://en.m.wikipedia.org/wiki/Social_robot)
- [14] <https://furhatrobotics.com/blog/the-7-best-use-cases-for-social-robots/>
- [15] <https://www.reliancedigital.in/solutionbox/the-workings-of-robotic-vacuum-cleaners/#:~:text=Most%20robotic%20vacuum%20cleaners%20use%20one%20or%20two%20spinning%20brushes,into%20a%20removable%20dust%20container.>
- [16] <https://newatlas.com/robotics/yardroid-gardening-robot/#:~:text=The%20Yardroid%20robot%20was%20designed,not%20unlike%20a%20miniature%20tank.>
- [17] <https://techcrunch.com/2020/03/04/this-bathroom-cleaning-robot-is-trained-in-vr-to-clean-up-after-you/amp/>
- [18] <https://images.app.goo.gl/EgojMBoYk4xBtyoc6>
- [19] Kavya S, Karthik M, Kumar CA. Automatic skyscraper window cleaning system. Int. J. Robot. Autom.. 2017 Mar;6(1):15-20.

``

[20] [https://smrobotics.com/security\\_robot/security-surveillance-robot/](https://smrobotics.com/security_robot/security-surveillance-robot/)

[21] <https://www.dhs.gov/science-and-technology/news/2020/04/07/snapshot-us-israel-empower-bomb-squad-robots-second-arm>

[22] <https://www.plainconcepts.com/autonomous-robots-security/>

[23] <https://www.trihealth.com/dailyhealthwire/health-topics/robotics/4-advantages-of-robotic-surgery>