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A Review on RoboticTechnologyand its Applications

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***Abstract*-The research in the subject of robotics has been undergoing a major change from manufacturing applications to entertainment, home, rehabilitation, search and rescue, and service applications.Because of its speed, capacity to work in hazardous situations, and ability to do repetitive tasks with accuracy, robotics is essential. The goal of this article is to explore the detail study on Robotics and its Applications in various fields.**

Keywords-*Robotic, Sensor,Actuators, Health care Robots, Industrial Robots, Functions of Robots*

I. Introduction

A robot is a reprogrammable, versatile manipulator that performs a number of tasks by moving material, parts, tools, or specialized devices through changeable programmed motions. The Robot Institute of America was founded in 1979. The robot institute of America was established[1]. Czech playwright Karel Rassum wrote word "robot" means "worker" or "servant" [2]

II. History of Robots

UNIMATE is the first industrial robot. In 1954, George Devolplans the first programmed robot, [3] in 1978, Unimation develops the Puma robot with GM's help. In the 1980s, the robot business enters a period of quick development. NASA's Mars Exploration Rovers will send off toward the Red Planet from 1995 to 2003 in search of answers on the origins of water on the planet. [2] According to the International Federation of Robotics, 421,000 industrial robots were shipped worldwide in 2018. (IFR). Canvas Technology, a delivery start-up, has developed autonomous delivery trucks for the final few feet of delivery [4]

Fig. 1 Mill machine tending [4]

Fig. 2 Fanuc launches a greatly expanded range of robots [4]

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III. FUNCTIONS OF ROBOTS

A robot's functions can be divided into three categories:
"Sensing," "action," and "communication."Sensors are critical components for industrial robots to do their tasks. Sensor data can be utilized to assess the state of industrial robots as well as the external environment, assisting in the control and regulation of robots to perform assigned tasks. [5]

Fig. 3 Robot that can see, here, feel

A. Decision Making

Robots use artificial intelligence (AI) approaches to plan and make decisions, allowing a machine to figure out how to execute a task successfully. AI planning approaches use a set of planning administrators to code the state changes in the [6]. environment caused by a robotic activity in order to make decisions.[7]

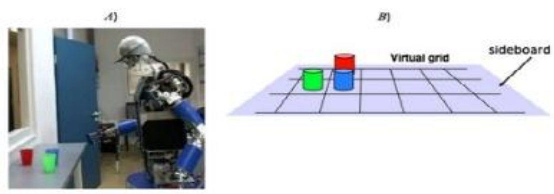

Fig. 4 Performance of complex situation with any blocking cups [7]

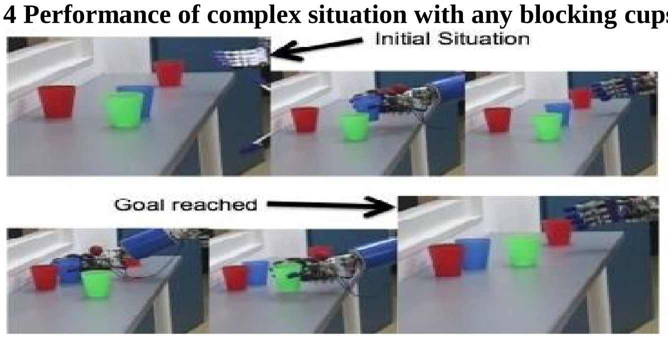

Fig. 5Using cups as objects and a Robot does a task [7]

B. Performing

Executing": Task-based performance testing, which involves robots performing urban search and rescue duties, is one technique to measuring machine intelligence. As a resultrobots' performance in industrial settings, hazardous areas, and exploration will improve[8].

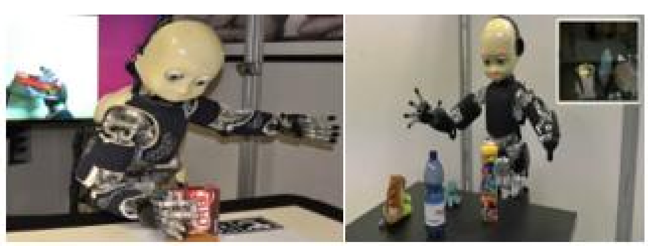

Fig. 6Performing to take various objects to complete the task [8]

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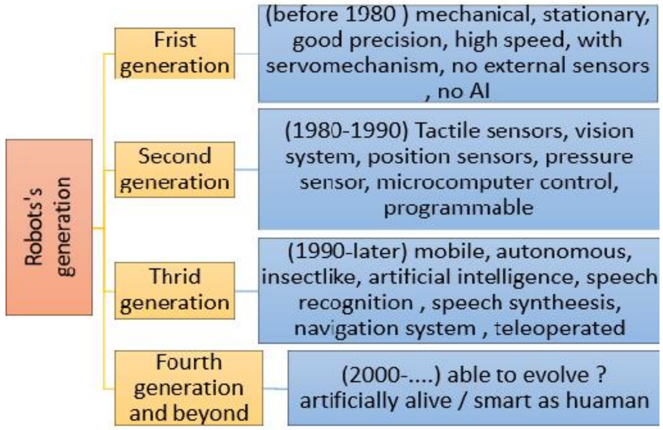

Fig. 7 Philosophical Considerations of Robots [2]

IV. LAWS OF ROBOTICS

The Three Laws of Robotics were written by Isaac Asimov, a popular science fiction writer.

1) A robot should not harm a person or permit a person to came to hurt because of its [3]inaction.
2) Except when it conflicts with the first law, a robot must always execute directions issued to it by a human.
3) Except where the first or second laws are violated, a robot must safeguard its own existence [9].

V. COMPONENTS OF ROBOTS

The key components of robots are discussed as follows:

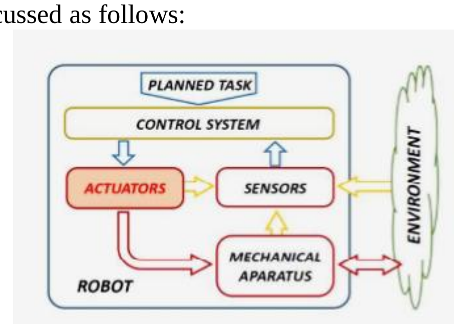

Fig. 8Robotic Block diagram of Robot [10]

A. Sensors

Robot sensors are parts of an automated framework that collect information about its internal status or exterior elements; [11]. awareness of these factors is required for the robot to fulfil its tasks.[10]

B. Sensors are divided into two groups:

1) *Internal Sensors:*These measure physical data such as location, speed, speed increase, powers, forces of robot joints, and inactivity of robot connections that are internal to the system. Based [11].

2) *External Sensors*: These collect data on the robot's environment, such as object distances, light and temperature measurements, and forces encounteredwhen interacting with the world [11].

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Fig.9An autonomous vacuum cleaner with internal sensors (gyro sensor, speedometer,pull sensor) also outer sensors (top and bottom views) [11] (dust-in sensor, bluff sensor, infrared sensor collector, divider sensor, collision sensor, drop sensor).[10]

C. Actuators

Actuators, which are the components responsible for the motion of links in line with desired trajectories, play this duty in robots. To run the robot, an actuator turns a primary, readily available kind of energy into mechanical energy. [10]

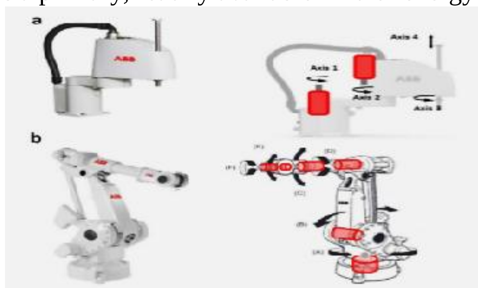

Fig. 10The ABB IRB 910SC (4 axes) vs. the ABB IRB 4400 (6 axes), with the places of different actuators marked in red4F*. [11]. ABB claims the picture privileges [10]

D. Power Source

Batteries, hydraulic, solar, or pneumatic power sources provide the robot with its operating power.[10]

E. Control

A controller is a component of a robot that coordinates all mechanical system motion. It moreover gathers information from the nearby climatevia a variety of sensors. A microprocessor is at the heart of the robot's regulator, which is coupled to the input/output and checking gadgets[10]

Fig. 11Robotics Controller [10]

F. Electric Motors (DC/AC)

Motors are electromechanical components that convert electrical energy to mechanical energy equivalents. Motors are utilized in robots to provide rotational movement. [10]

Fig. 12Stepper motor, Servo motor, Muscle wire, DC motor [2]

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VI. TYPES OF ROBOTS

Robots are broadly classified in to two major group and it is given in the fig. 13.

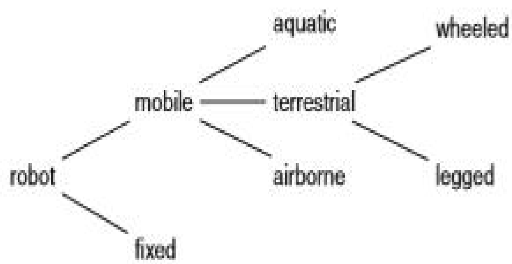

Fig. 13 Classification of Robots [12]

A. Mobile

Mobile bases are regularly stages with wheels or tracks attached [13].

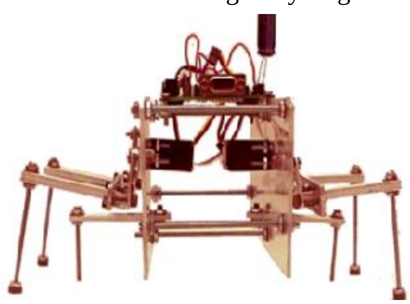

Fig. 14 Mobilerobots [14]

Types of Mobile Robots

1) Aquatic robots

Exploring the waters and undersea locations that are inaccessible to man is one of man's oldest pursuits. The underwater vehicle manipulator system is one of the hottest study subjects today as a division of mobile robotics.Many equipment, including robotic systems, have been developed for this purpose. An example of a submersible robot is Ocean One. It's a humanoid robot that investigates the ocean floor [15].

Fig. 16 Underwater search robots [2]

2) Terrestrial robots

i. WheeledRobots

Rolling Robots travel around on wheels. These are the robots that can search and move about swiftly and easily. They are, however, primarily useful in flat places; rocky terrains are difficult for them to navigate. Their domain is flat terrain [16].

Fig. 17 Autonomous mobile robot weeding a field [12].

ii. LeggedRobots:

When the terrain is rugged and difficult to approach with wheels, robots on legs are frequently brought in. It's difficult for robots to maintain their equilibrium and avoid tumbling. That's why most robots have at least four legs, and most have six or more. They hold their balance even when lifting one or more legs[16].

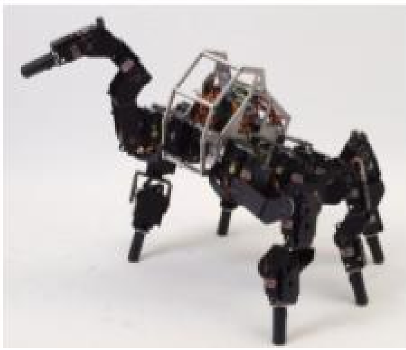

Fig. 18Legged Robots [17]

iii. Tracked slip/skid locomotion robots

Treads or caterpillar tracks are used instead of wheels in these robots. We assume that wheels cannot skid against the surface in the wheel configurations. Another steering option, known as skid/slip, involves spinning wheels in the same direction at different speeds or in opposite directions to reorient the robot [15].

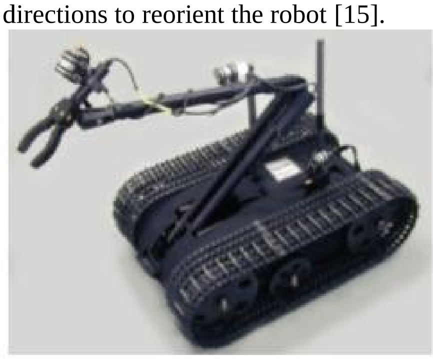

Fig. 19 Tracked robots in spinning wheels [17]

iv. Hybrid robots

These are robots whose structures are made up of a mix of the sorts listed above. A segmented articulated and wheeled gadget, for example. The appropriateness of wheels is combined with the adaptability of legs in hybrid solutions. According to Bruzzone1 and Quaglia, there are four different types of hybrid mobile robots [15].

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Fig. 20 Hybrid robots used as delivery robots [18].

3) Airborne robots

An unmanned aerial robot, or "drone," is a machine that follows the operation of an aeroplane and executes a preprogrammed mission with or without human contact. The most advanced can currently take off and land entirely independent of their operators' activities. Initially, they were primarily used for military purposes, but they quickly expanded to include scientific, agricultural, commercial, recreational, policing, and surveillance, product deliveries, distribution and logistics, aerial photography, and other uses (see Paul77 for a comprehensive overview of "drones") [15].

Fig. 21 Airborne robots used as delivery robots [18].

4) Stationary Robots

Stationary Robots are utilized for more than only exploring new places or imitating humans. In industry, most robots "work" by performing repetitive duties without ever moving an inch.

Cartesian robot: a robot with three prismatic joints and axes that correspond to a cartesian coordinate system.
SCARA robot:A scara robots is a robot with two parallel rotary joints that provide compliance in a plane [19].
Articulated robot: A robot with articulation at the very least three rotating joints is known as an articulated robot [20].
Parallel robots: A parallel robot is one with arms that have parallel prismatic or rotational joints.
Cylindrical robots: a cylindrical coordinate system. [20].

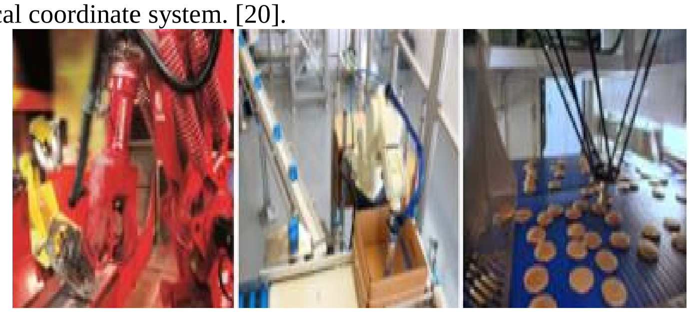

Fig. 22 Handling for metal casting, Packaging, placing and packing [20]

5) Autonomous Robots

Autonomous robots are self-sufficient or, to put it another way, self-contained. They rely on their own 'brains' in some ways. Autonomous robots follow a programme that allows them to choose which action to take based on their immediate environment these robots are even capable of learning new behaviours. They start with a simple routine and gradually improve it. at the task at hand you ‘ll be successful [16].

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Fig. 23Types of Autonomous robot with a manipulator [21].

6) Remote-Control Robots

A robot can be guided by a person via a remote control. A person can use a remote control to direct a robot. Without being present at the location where the duties are conducted, a person can perform complex and often risky tasks [22].

Fig. 24Remote control robots [22]

7) Humanoid Robots

It has a head, body, arms, and legs, just like a person. It has sensors that allow it to sense its surroundings. Sophia, for example, is a social humanoid robot built by Hong Kong's hanson robotics.[22]

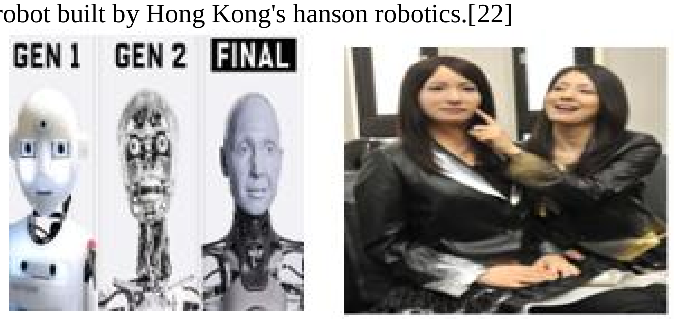

Fig. 25Humanoid Robots[22]

B. Fixed

Robots used in manufacturing are examples of fixed robots. They cannot move their base away from the work being done [13].

Fig. 15 Fixed robots [14]

VII. Robotic Applications

Applications of Robotics are grouped into the following categories.

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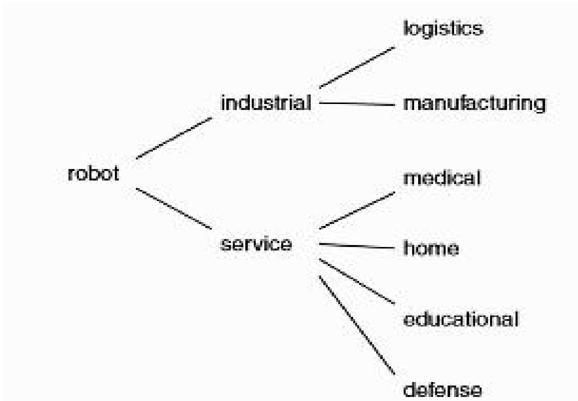

Fig. 26Robots are divided into categories based on their applications [23]

A. Industry

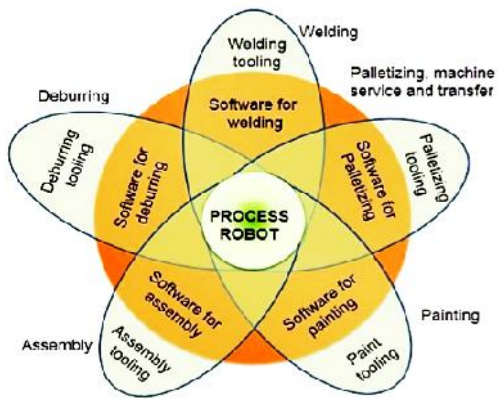

Fig. 27 Types of Industrial robots [24]

Pick and place, assembly, welding, spray, painting, deburring, machining, and other industries. Industrial robots are present in all manufacturing processes[7] .

Fig. 28 Painting, spot welding, laser welding [2]

B. Medicine

Occasionally, doctors must operate with the assistance of a robot. When it comes to creating pharmaceuticals, robots are far more efficient and accurate than humans. A robot can also be more sensitive than a human. [25]

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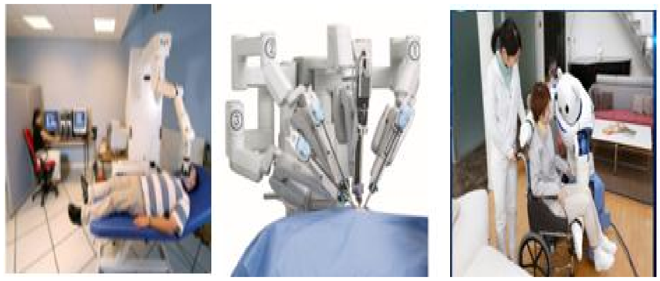

Fig. 29Examplesof a medical robots [17]

C. Prosthetic

Some doctors and engineers are also working on robotic-based prosthetic (bionic) limbs[26].

D. Teleoperation

Human-directed motion using a joystick is referred to as teleoperation. Haptic interfaces are unique joysticks that allow the human operator to have the same sensations as the robot [18].

Fig. 30Robotic-based Prosthetic (bionic) limbs.

VIII. ROBOTS UNDER COVID-19 PANDEMIC

Due to the difficulties posed by COVID-19 and its related lockdowns, many people and businesses have turned to robots to help them handle the pandemic's hurdles.

A. Robots for Covid-19 Diagnosis

An automatic liquid-handling robot that will analyze swabs to diagnose patients. Covid 19[18]

B. Robots for Screening

Dronesrobots check the temperature of persons who had been isolated in their homes[18]. Individuals who have a combination of a high body temperature, a high heart rate, and a high blood pressure[27] suggestive respiration rates, and coughing can be detected by the pandemic drone. Misty conducts a temperature-sensing test and asks a series of questions.

C. Uv-c Robots

Xenex's light strike robot. A robot that can detect UVD [28] moves througha surgery room, sanitizing it.MIT has a robotsterilizing the corners of a laboratory space. The food bank is being disinfected by a UV robot.

D. A spray liquid disinfection robot

A liquid disinfection robot that moves around the hospital and sprays liquid agent

E. Teleoperated Robots used in Covid-19

The helper imitates the movements of the ultrasonography from a distance distant from the sonographer. Boston Dynamics' Spot robot is being used to screen arriving patients and collect vitals remotely.

F. Social and Care Robots.

Computer vision and navigation algorithms are used to monitor social distances. Patient and staff are featured in the Lio Robot with HRI. The Humanoid Robot from ARI (PAL Robotics) intends to improve social interaction. During the demonstration, the cruzr robot (UBTECH robotics) monitors the temperature at a medical facility.[18] professional. In a hospital, Moxi (Diligent Robotics) is caring for patients.

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G. Delivery autonomous ground vehicles.

The name of the robot is scout, and the White Rhino robotic delivery [28] lunch boxes to hospital personnel using self-driving automobiles and the UDI self-driving vehicle, Hercules. Nuro transporting medical supplies to a makeshift clinic. Drones that can transport packages on their own. Walmart's pilot drone delivery robot, Wing delivery drone, Zipline delivery drone During the epidemic, UPS has initiated two healthcare-related drone delivery studies.

H. Collections of garbage from patient bedroom

By collecting waste from the patient's room, robots can play an important role. They are able to take waste on a regular basis.

I. Food for admitted covid-19 patient

This technology was used in hospitals to serve food to admitted patients and retrieve their utensils. This lowers the risk of infection for the healthcare provider.

J. Sanitizing locations and hospitals

Using a robotic stand, sanitizer can be distributed to various people at unusual locations. Many hospitals are using it for sanitizing reasons in order to quickly combat the pandemic. It distributes the right. A sufficient amount of sanitizer around the wards to prevent the speed of viruses and germs[29].

K. Assist covid-19 testing

COVID-19 patients are tested using robots by doctors (for example collecting a nose swab and a blood sample). It’s very efficient, safe, and speedy.[19]

L. Security robots used in covid-19

Outdoor protection and monitoring were critical during the covid – 19 pandemic [18]

Fig. 31 Robots for COVID-19 diagnosis, Robots for screening, social and care robots. Security robots, sanitizingthe hospital robots etc. [30].

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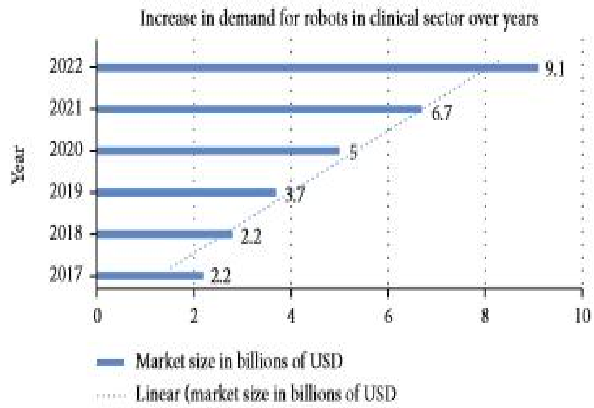

Fig. 32 Increase in demand for robots in clinical sector over years [30]

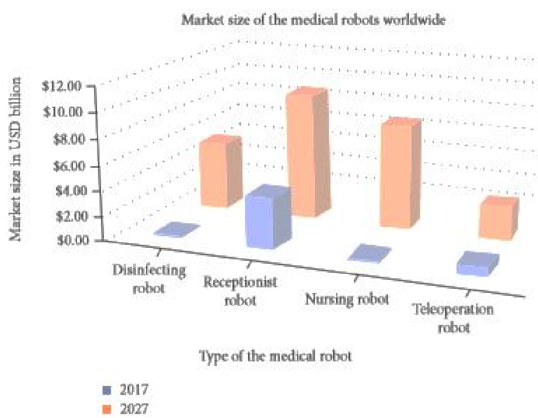

Fig. 33Market size of the medical robots worldwide [30]

C. Agricultural Robots

The use of modern technologies such as sensors, robotics, and data analysis to automate operations that were formerly done by hand is known as digital farming. previously, it was time-consuming. It also looks into a some of the most recen developments in agricultural [31] robotics, including those utilized for autonomous weed control, field reconnaissance, and harvesting on its own [23]

Fig. 34Apple Picker, Tomato Harvesting [32]

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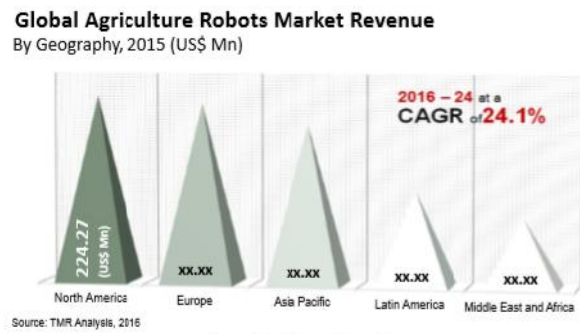

Fig. 35Global agriculture robots market revenue. [33]

D. Robotic Toys for Entertainment

The latest robot technology is resulting in a variety of fun toys for kids to play with. [17]

Fig. 36 Toys Robots [17]

E. Robot for cleaning at home and industry

At the end of 2001, vacuum cleaning robots were launched to the market. In the years 2002-2003, the market grew substantially. [17]

Fig. 37Vacuum Cleaner Robot [17]

F. Boats, Aircrafts and Robotics

Without a pilot, which is directed by a [20] ground station and are utilized by the army or rescue missions. [17]

Fig. 38Example of a robot aircraft [17]

A. Educational robots

Advances in electronics and mechanics have made it possible to build robots for a reasonable price. Educational robots are widely employed in classrooms and extracurricular activities in schools. The large number of educational robots makes a comprehensive overview impossible. We've included a few examples of robots that are often utilized in teaching [12].

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Fig. 39 Educational used in schools [12].

B. Soft robots

Soft robots are made of materials that are extremely flexible. They're frequently created using a lot of biomimicry, like octopi and elephant trunks. When compared to traditional rigid robots, their absolute rigidity and accuracy are quite poor. However, their safety is inherent, as is their ability to collaborate with humans and wrap items for gripping. They are frequently controlled by air (or other fluid) pressure and/or artificial muscles, which are far more difficult to manage than typical robot muscles [26].

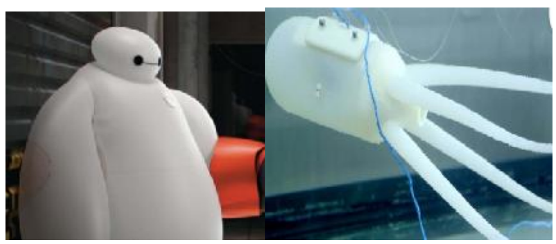

Fig. 40 Soft Robot and Octopus-Inspired Soft Robot [26]

G. Military Robots

Mobile robots that can be operated remotely and are used in military applications. They are outfitted with a camera and sent into enemy territory to capture and transmit photographs to the operator. [22]

Fig. 41Military robots [22]

H. Space Robots

They're known as rovers. In space, it's used for exploration. They're equipped with scientific tools for analyzing soil samples. Take pictures of planets. [22]

Fig. 41 Space Robots [22]

IX. Conclusion

Robotics has flourished in the previous two decades, in terms of both research and applications it has penetrated people's minds and practically all existing technologies.Robotics is about to reach a market share of $100 billion dollars. This article summarizes the classification and real world applications of Robotics in the field of Healthcare, surgery, housekeeping, autonomous vehicles, and, to some extent, entertainment are all on the horizon.

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