

Role of Robotics in Space

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ABSTRACT

Today space science is in the developing phase getting success in a land over the moon & mars. As we know the universe is expanding. We talk about only the known universe. We cannot succeed to explore so many planets of an unknown universe. To learn more about our universe as well as to understand any possibility of life on another planet NASA /ISRO / ROCOSMOS / BNSC /JAXA / CNSA / CNES like space agencies makes different program and checks the results. All space missions are not possible with astronauts. To avoid unnecessary risk so many countries try different animals for space travel but they do not succeed in it. Russia sends dogs first time for space travel & results we know very well. The new concept comes in front why not try robots for space travel and space missions yes, space robots are equally important. Curiosity, Pathfinder, Rover, chandrayan, Vikram is some of them. Space robotics deals with a substitute or subsidy for the man activities in space by a robot to minimize the risk and to increase the efficiency and accuracy. One of the most difficult uses of robots is in space. Space travel has always been dangerous, sometimes death also. The only way is to replace the astronaut with robots. Robots are the best alternate giving more accurate performance than a human being Today's robots are capable to navigate their way cleverly passing through every obstacle that comes in the way. In other words, robots are experts in Obstacle Avoidance, Mapping, and Path Planning. Robots have become the first choice for space travel as Robots can work efficiently in a hostile non-terrestrial environment Planetary surfaces can be explored more cheaply and quickly less expensive and dangerous incidents can be reduced. Intellectual control, mobility, reconfigurable approaches, and recognition are all desired features for space robotics devices. These characteristics necessitate significant advancements in computer science, mechanics, and control technology. New robotics system prospects in the cosmic environment are regarded as a high-tech priority that necessitates non-trivial and constructive architectures. Specific novel communication techniques, the effect of weightlessness and automatic behavior of robots cannot be verified on ground condition so that all innovative decision need to be tested and demonstrated in open space condition within realistic scenario time comes to introduce artificially intelligent humanoids in space giving more better results in search of existence of life on other planets too.

Keywords:-Robonaut, Autonomous, JSC, NASA, ISRO,ROSCOSMOS, BNSC, JAXA,CNSA,CNES Dextre

INTRODUCTION

There are 3 types of space robots

Planetary Rovers: These are the advanced robot long with the number of sensors which collect the data analyze it, process

it, explore and send the result back to earth.

In-Orbit Robots: These are robots that support an astronaut during a space trip. They are meant to refill a shuttle, allowing the astronaut to stay in his shuttle and complete numerous chores without risking his life.

Probes: These are the robots that do not land anywhere but in space typically use cameras and a variety of instruments to measure the distance from the sun, moon, and other planets in space.

Remarkable work by Robots in Space Exploration

The practice of sending robots to space began in 1957, when the Soviet Union launched Sputnik 1 into orbit around the Earth.

Following that, robotics exploration in space has witnessed a significant growth in the years since. Dextre, a robot arm designed to install and upgrade tiny components such as outside cameras or the hundred kilograms batteries used on the space station, was just released by the Canadian Space Association.

Dextre is now managed by teams from both the Canadian Space Association and NASA. R5, which was originally created at the Johnson Space Center (JSC) for the DARPA Robotics Challenge in 2013, is now a part of NASA's Space Robotics Challenge.

The six-foot-tall robot is now undergoing software upgrades required for space travel by NASA. The robot's gripper hands, sensors, and cameras in the head and chest are meant to help astronauts perform a wide range of tasks in space.

Mission Shakti, which was released by India, is an anti-satellite weapon that uses AI and robotics to ensure precision and interception in order to precisely find and kill its target.

India's Orbiter made great use of technology. Pragyan is a lander with machine learning and AI in its Rover.

The moon project rover ensures that the robot collects specimens from the lunar surface, takes images and films, and uses the technologies built-in.

The NASA Institute uses robots in a variety of ways. Hands-on robotic spacecraft are used to transfer very huge objects into orbit. Spacecraft that go to various worlds are robots that can do tasks on their own.

They are given instructions by others. The robots then carry out the commands. The rovers that explored Mars' surface are examples of this type of robot. Robotic planes are capable of taking off and landing without the need for a pilot.

The NASA Institute is developing new types of robots that will be able to assist and collaborate with people. NASA uses robotic arms to transport large items in orbit.

The "Canadarm" robot arm of the space shuttle flew for the first time in 1981 during the shuttle's second mission. The larger Canadarm2 may be found on the International Space Station.

The space shuttle's arm has performed a variety of tasks. It might be used to launch or upgrade satellites.



Fig.1:-The International Space Station's robotic arm, Canadarm2. By NASA Institute



Fig.2:-Autonomous Robot

Dextre is connected to the end of the International Space Station's robot arm, Canadarm2. by NASA-Institute.

On five separate maintenance missions, the arm has been deployed to capture the Hubble Space Telescope. The shuttle and space station arms collaborate to help build the station.

The robot arms were employed to move new station components into place. On spacewalks, the hands can also be used to maneuver astronauts around the station. The arm of the space station may move between different parts of the station.

Robots Explore Other Worlds

The NASA-Institute uses robots to help them understand more about the solar system and the universe.

All spacecraft that explore other worlds, such as the moon or Mars, are robots. These robots are made up of rovers and

landers that may be found on the surfaces of several planets. Spirit and Opportunity, the Mars rovers, are examples of this type of robotic.

Other robotic spacecraft travel by or circle other planets, observing them from afar. Cassini is a robotic spacecraft that studies Saturn and its moons and rings.

The Voyager and Pioneer spacecraft, which are now traveling beyond Earth's solar system, are also robots. These robots are self-contained, unlike the robotic arm on the space station. This means they'll be able to operate alone.

They carry out the commands that people give them. To communicate with the spaceship, people employ computer systems and powerful antennas. The robots have antennae that pick up the communications and transfer the instructions to their computer systems. The robot will then obey the directions.

Robonaut

These are Robots that facilitate Astronauts from NASA- Institute is developing new robots that would help people in space. Robonaut, for example, is an example of this type of concept.

Robonaut appears to be a human's upper body. It has limbs, a chest, and a head.

Robonauts should work outside of a spaceship, doing activities similar to those performed by astronauts during spacewalks. Robonaut should be able to work on the moon or on another planet with wheels or another mode of transportation. Robonauts might assist astronauts and work alongside them.



Fig.3:-Robonaut robot by NASA Institute



Fig.4:-K10 Robot by NASA Institute

SPHERES is a different robot idea. These are miniature robots that resemble soccer balls in appearance. SPHERES are now acclimating to the space station in order to see how well they can circulate in microgravity.

Similar robots should one day fly around the space station assisting astronauts. K10 is a robotic explorer that has investigated craters, lava flows, and deserts in order to help human explorers.

The NASA Institute is also looking at the possibility of a different robot. A tiny model of the station's robotic arm, for example, may be utilized in the station. In an emergency, a robot like that may come in handy. A physician on Earth may

command the robotic arm to do surgery if an astronaut was seriously injured. This technology might also be useful on Earth. Doctors might utilise their knowledge to assist individuals in distant areas.

Scout Robots

Robots can also be deployed as scouts to investigate new areas. Scout robots can photograph and map the landscape. This makes it easier for scientists and engineers to devise more ambitious exploration programme.

Scout robots can be employed to look for dangers and attractive places to stroll, drive, or halt. As a result, astronauts can operate more safely and efficiently. It's

simpler to investigate other planets when humans and machines collaborate.

METHOD

A robot is a collection of sensors, actuators, controller radio communication, and power supply working together as a unit using much software. Space robots are works on sense, plan, and action algorithm all robots in space do their job in following steps.

Robots Job in Space

1. **Planning:** It is a feature by which robot understand the situation & decide the strategy to tackle it
2. **Sequencing:** It consists of the selection of a particular skill set those results from the perfect execution of a plan
3. **Control:** It consists of preformation of selected skill to it would set to perfection. Space robotics involves following tasks
4. **In orbit positioning and assembly:** It is carried out for deployment of satellite and assembly of modules to satellite /space station
5. **Operations:** These include conducting experiments in a space lab
6. **Maintenance:** It involves removal and replacement of faulty modules /packages
7. **Resupply:** It consists of a supply of equipment, materials to conduct the experiments in a space station and maintain a life support system, and also resupply fuel.

The following type of experiments are conducted in space

- Metallurgical experiments
- Astronomical Observations
- Biological Experiments.
- Refueling
- Faulty modules Replacement
- Assist Jammed Mechanism (Solar Panel Antenna)

- Assist in deployment and assembly outside the station.
- Assist crew inside the space station
- Routine crew functions inside the space station.
- Maintain life support system in space
- Replacement of payloads by an upgraded module.
- Attach an extra module in space
- Grab Satellite and affect an orbital transfer
- Efficient transfer of from low earth orbit to geostationary orbit

General Robots vs. Space Robots

It is important to understand that general robot that works on earth are different from space robots.

These robots have to operate in zero gravity, sometimes in a vacuum, and some time in thermal gradients such robots are very long distance to earth's atmosphere measured in light year There are remarkable effects of zero gravity on the physical action and mechanical performance of the robot.

There is space influence of thermal and vacuum conditions on the material and sensor functions The degree of remoteness of the operator may also vary from a few meters to hundreds of thousands of kilometers

The principal impact of distance is the time delay in command communication and motion of arm For nearly a century, countries all around the world have been racing to find space. Surprisingly, there is no win.

As more rockets and satellites are sent into space, more information on the floating components is gathered. The space exploration technique, like many other sectors, is utilizing Artificial Intelligence (AI) and robots to expedite their endeavor.

This takes us to incredible lengths and locations we've never visited before.

Future about Space Robotics

Artificial intelligence used to be less flexible in the early days of technology. People have taught AI systems through input data that involve the difficult process of writing computer codes. Today,

however, the situation has flipped on its head.

Machine learning and deep learning, for example, are easing the burden on AI. This presents an opportunity for space agencies to include AI and robots into their missions. Machine learning allows AI to train itself using a large quantity of data.



Fig.5:-Artificial intelligence (AI) and space robotics

Deep learning is a subset of machine learning in which a computer uses multi-layered artificial neural networks to train itself on difficult tasks such as image recognition.

Robots are entering space and reaching places that human astronauts are unable to reach. These innovations are only the tip of the iceberg. We'll find much advanced AI technologies being used in area operations if we dig deep into AI and robots. The value of AI in space exploration is estimated to be about \$2 billion and rising.

AI advancements have an influence on both humans and scientific exploratory endeavors. Scientists have set a goal to find the moon, Mars, asteroids, and comets by 2020 and beyond. With the use of technology, these may be accelerated and enhanced.

Autonomous position tracking, navigation, and map-building, SLAM technology, defect detection, isolation, and recovery

methods, picture processing, object identity and characteristic detection, job planning, and scheduling are some of the artificial intelligence systems used in space missions.

The mechanical architecture of planetary rovers, the mechanical design of space manipulators, space robot actuators and sensors, space robot end-effectors/tools, reconfigurable robots, and robot mobility all contribute to the space exploration process.

Not just space academics and scientists, but also governments all around the world are expressing interest in using AI and robots to become more powerful. Space manipulation, which is carried out by articulated robots, is the process of servicing equipment or equipment in space.

Polybot is ideal for maintenance and inspection on a space station or satellite. Robotic manipulators are being developed for use in space or on other worlds to

mimic human manipulation skills. They are often found on free-flying spacecraft or in space vehicles, planetary landers, and rovers, as well as on-orbit tuning of other spacecraft. I'm excited about the prospect of hydrogen fuel for space travel, and if it becomes a reality, we'll be able to fly further into space and achieve more.

CONCLUSIONS

It is observed that robotics play an important role in space exploration. Robotics makes space missions economical, effective, accurate, and safe and gives long-term help through long stay which is not possible for astronauts. The most important thing is that the number of mysteries is solved and the scientific attitude is increased with every space mission. Only the drawback is that Robot does not have common sense and will power but astronaut along with them.

RESULTS

Artificial Intelligence (AI) and robotics now take place in space exploration for speed and accuracy in mission. The reasons are so many, such as space travel being economical as an astronaut needs the number of facilities and food.

Those facilities are not necessary for robots. In space robots are safer than an astronaut, Robots found to be more accurate & result oriented than astronaut as robots are along with several modern sensors to read attributes from any planet

Robots gives long term response and sends reading on earth where scientist analyze Information got from space, Astronaut is a human being so till some limitation exist but robots are found advanced & technologically sound as compare to the astronaut. We hope in the coming days with the hydrogen fuel it may be possible that we can explore an unknown universe

via journey from one planet to second and second to third.

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