

# Artificial Intelligence: An Overview of Robots in Space

Seema Gusain<sup>1</sup> Prof. Saoud Sarwar<sup>2</sup>

<sup>1</sup>M.Tech Research Scholar, <sup>2</sup>H.O.D. Department of Computer Science

<sup>1,2</sup>Al-Falah School of Engineering and Technology, Dhauj, Faridabad-Haryana

*Abstract*-- Robotics is a branch of artificial intelligence. The computer science and engineering field are integrated for creating a device which moves and react to a sensory input, is known as Robots. The use of robots is widespread in space. The space robotics are used on other planetary surfaces for exploration and research. They work on an outer space where it is hazardous for humans to work. Robots work in vacuum, low gravity and high temperature. This paper is a basic study on space robotics and what are the mobile robots in space.

*Keywords*: Robot, Space Robotics, Issues, mobile robots, Sensors, Actuators, Applications of robots.

## I. INTRODUCTION

Robots are a device or tool which is designed by computer science or engineering field to do different types of tasks and react to a sensory input. Robot word comes from the Czech word 'robota' which means labor work. "Robot" is a machine which is made by man to perform tasks or other actions that are dangerous for humans.

They are the tools to help us in achieve things and they are used in factories, underwater and other planets[1]. One of a very important use of robots is in space explorations and discoveries. Today a large number of Robot are on planetary surface of, mars.

An outer space is a rough or harsh environment and work on this extra-terrestrial environment is more risky but the curiosity of the scientist is increasing day by day and they want to know more and more about, beyond the human access. Hence space robotics is contributing in gaining more and more knowledge of outer space and its unknown territories especially on other planets. This paper is based on a basic study and overview of space robotics and discuss what are the issues in space robotics.

## II. ROBOTS

Robot is a machine or tool powered by electricity, water and air. It is reprogrammable and can work in those conditions which are hazardous for humans. The robot word was first introduced by Czech playwright Karel Capek in the year 1921. Robotics technology is a multidimensional. In this technology several fields of engineering are involved Like: computer science, mechanical engineering, electronics, electrical and artificial intelligent [2]. The robot has three main parts:

1. Controller- the brain.
2. Mechanical Parts- for Movements.
3. Sensors- to tell about its surroundings.  
These parts to make a device which is to move, perform a task it means to control the activities of

Robot and how a robot works [3].

## III. SPACE ROBOTICS

The Space robotics is developed for the space environment they have different type of size and variety of functions. These devices are automated and give a name robot which means a device which works remotely or automatically according to programmed instructions.

The robot is the replacement of manual work, it helps where a large number of physical manpower is used to perform a work, which took years and is dangerous for human. Robot easily perform tedious types of task (repetitive, hazardous and menial) and it also decrease the time and cost. "Robot is also known as a man like device because it performs human actions and shows the behavior just like humans.

All space robots comprise of these parts - a controller, a sensor, actuators, power and radio communications system. The sensors tell about surrounding environment. It senses the surroundings and sends the information to the controller. Controller processes the input data coming from sensors and sends commanding signals to the actuators. The actuators receive the signal and convert it to appropriate physical actions [4].



Fig. 1: Space Robotics

## IV. SPACE ROBOTICS ISSUES

There are some Issues in Space Robotics.

### A. Mobility

Moving a device remotely, especially in space also have a complexity because movement does not mean to move directionless but try to move accurately and quickly and without the collision with any object. In order to move a device in an appropriate direction we have to ensure that it should not collide with an object. We have to identify solution and resolve this problem through space Robotics. Rovers are also an example of mobile robot which is capable of moving in extra-terrestrial environment.

### B. Manipulation

Manipulation means that the device smoothly uses its mechanical parts as hands and arms. We need accuracy and speed in appropriate direction without collision or accident. We need to overcome all these issues so that the robot moves smoothly at an unknown surface. Also with the parts of the device to work with skill is also a great issue.

### C. Time Delay

The space robotics involves great distances and the instructions generated at the control station needs to be processed by the space robot. Sometimes in dynamic conditions there is a delay in the execution of the instruction. And a challenging task to instruct remote space robot.

### D. Environments

Creating a device for extra-terrestrial environment (extreme heat or cold) and operating in radiation, vacuum, dust and corrosive environment etc. is also a challenge or an issue for researcher[5].

## V. MOBILE ROBOTS

Mobile Robot refers to a device which has a capability of perception and moving easily in any environment (underwater, air and surface of planet). It is unique in its ability to sense its surroundings and give a response for movement in that environment. Modern space robots are versatile fast and capable of moving in all kind of terrains with minimal collision. [6].

The mobility is utilized for exploration of the surface, the material present and observe the gas , air present around. Space mobility due to space robots has given us tremendous knowledge.

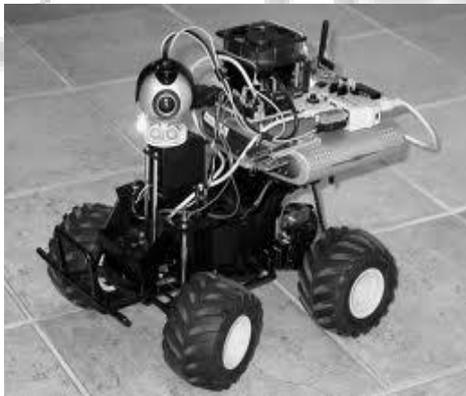


Fig. 5: Mobile Robot

### A. System of Mobility

Mobile robot is an essential for space exploration because of its capability to move in the extreme environment of space. It is harsher than earth environment [7].

Here we have discussed few categories of mobile systems utilized for movements under extreme conditions and according to the specific requirement of the task assigned for movement.

#### 1) Rovers

The rovers are mobile robot move on the planet surface they  
Micro rovers:- Micro rovers are less than 5 kg and covers 10 meters or less.

Mini rovers: - Mini rovers are less than 100kg mass and capable for moving in venture environment and these capable of moving in few of hundreds meters.

Large rovers: Large rovers are less than 100 kg in mass. These are capable of moving many kilometers.

#### 2) Hoppers

These robots can easily move in low gravity conditions. There are two types of hoppers first one is a rocket type and second one is mechanical type. Example of mechanical hopper is a Soviet Fobos , Minerva hopper , Philae lander.

#### 3) Aerobots

Aerobots are capable of easily flying in the atmosphere. It is of two classes Lighter than Atmosphere and Heavier than atmosphere.

#### 4) Subsurface robots

Subsurface robots can move easily under the planet surface. When we explore the surface of planet then there is need for subsoil investigation.

These are of two type 1-Robotised Drills. The head of this machine goes to the subsoil and analyses the environment of sub surface and 2-Robotic Mole. It is ideal is for deep research

#### 5) Underwater robots

These robots move in water. The popularity of such type of robots is not much .So scientist are devoting minimum effort of it.

## VI. PLANETARY SURFACE EXPLORATION

The exploration of planetary surface is very complex because the surface of planet is harsh , low gravity, low and high atmospheric pressure and there are several factors to make planet surface exploration. There are many probes which are used for exploration and they have limited range to survive but the rovers can easily survive in extra-terrestrial surfaces [8]. The scientist or researcher interest is increasing day by day for exploring the surface of planet, mars, moons and those planet that are more distant from earth [9]

The rovers (mobile robots) are comfortable to move in planetary surface and they can easily move in craters, deep narrow gorge and steep terrains.[10].

## VII. MISSION OF SPACE ROBOTICS

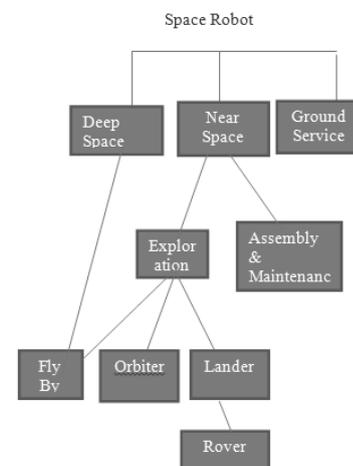


Fig. 8: From David Wettergreen, Space Robotics, Carnegie Mellon University, and December 8, 2004 [11]

## VIII. CONCLUSION

This paper is an overview and the study of space robotics and tells about mobility of system. Space robotics is a great invention because in the planet or orbit there is a rough environment extreme heat, low gravity and performing the activities in this field is dangerous for humans. There are the several places in the space where humans never reached and the exploration of this area was stopped.

But the space robotics gives us opportunity to explore this environment and send the information or images of unsearched planet by this it is convenient for researchers. This paper also present what is the space robotics mission. The space robotics is also a moving tool on the surface of planet and the researchers also send humanoid robots which have a four wheel for moving on the planetary surface.

## REFERENCES

- [1] <http://www.indianinstituteofrobotics.com>
- [2] SHAKHATREH, FAREED, The basics of robotics, Lahti University of Applied Sciences, Machine- and production technology.
- [3] [http:// ND National Robotics Week.html](http://ND.NationalRoboticsWeek.html), What Is Robotics — ND National Robotics
- [4] <HTTP://ROBOTS.OPEN.AC.UK/SPACE/MISSIONS.HTML>, ROBOT SPACE EXPLORERS
- [5] Brian Wilcox, Robert Ambrose, Vijay Kumar, Space Robotics, Chapter 3
- [6] Pedro Lima Maria Isabel Ribeiro, Mobile Robotics, Instituto Superior Técnico/Instituto de Sistemas e Robótica, March 2002
- [7] Robot mobility system for planet surface exploration – state-of-the-art-future outlook: A literature survey
- [8] [http:// Wikipedia.com](http://Wikipedia.com), Planetary surface exploration
- [9] P. S. Schenker, T. L. Huntsberger, P. Pirjanian, E. Baumgartner, H. Aghazarian, A. Trebi-Ollennu, P. C. Leger, Y. Cheng, P. G. Backes, Robotic automation for space: planetary surface exploration, terrain-adaptive mobility, and multi-robot cooperative tasks, Massachusetts Institute of Technology, California Institute of Technology
- [10] Christopher A. Brooks, Karl Iagnemma, Self-Supervised Terrain Classification for Planetary Surface Exploration Rovers Massachusetts Institute of Technology Cambridge
- [11] David Wettergreen, Space Robotics, Carnegie Mellon University, December 8, 2004