EXPLORATION TASK

Whenever I think of INDIA, I would always remember MANGALYAAN which is INDIA's most successful mission to get into other planet to study the environment there, and also to compete with other developed nations.

Mangalyaan (2014) is a project of ISRO (INDIA).

There are some rovers which were sent by NASA , CURIOSITY(2011) and PERSEVERANCE(2020).They were landed successfully on mars and doing their job right now.

ROVER is a kind of robotic machine which is designed to explore the surface of a planet or other celestial bodies. They are commonly used in space exploration to gather data and samples from other planets, such as Mars. Rovers are equipped with a variety of scientific instruments, cameras, and other equipment to aid in their exploration and data collection. They are typically controlled remotely from Earth, although they may also have some level of autonomous capability to navigate and perform tasks on their own. Rovers can be designed to operate on wheels, tracks, or legs, depending on the terrain they will be exploring.

They were short and small in early times as that their work would also be less now its huge as size of a car. Which have more specifications than them both curiosity and perseverance(percy) were of size of a car but percy has more smarter than curiosity.

1)*They are designed with different parts which helps it to get its work done some of the important parts are:*

Chassis*: It is the structure of the robot it contains all the other parts in it.*

Wheels*: there will be more or less than 6 wheels for the rovers which help for locomotion of the rover as the wheels will rotate 360 degrees rover will be able to navigate in all directions.*

Power systems*: Rovers typically rely on a combination of batteries and solar panels to generate and store the power they need to operate their systems and equipment. As solar panels are available everywhere in all the planets the solar energy will be available there in mars so we can use it and convert into electric energy to charge out batteries.*

Communication systems*: This is the most important subsystem it is the main part which communicates with us. Rovers need to be able to communicate with Earth-based controllers in order to receive instructions and transmit data back to Earth. This requires a sophisticated communication system, including antennas and radios. Antennas used to send and receive radio signals.*

Scientific instruments*: Rovers are equipped with a variety of scientific instruments, such as cameras, spectrometers, and drills, to help them collect data and samples from the surface of the planet they are exploring.*

Navigation systems*: In order to navigate and avoid obstacles, rovers are typically equipped with a variety of sensors, including cameras, laser rangefinders, and inertial measurement units (IMUs). These are the main they should work automatically according to the environment there on the surface of the mars.*

Environmental control systems*: Rovers also need to be able to protect their sensitive electronics and equipment from the harsh conditions of space and the surface of other planets. This requires environmental control systems such as heaters, coolers, and radiation shields.*

Life Detection Systems*: This is also an important one to make our mission successful they can be manual also in which they can be automated by the scientists on earth but it is not suitable here because of more distance between the planets so automatic detection is required here. First rover approaches to a suitable area and it takes the sample using instruments like drilling and scooping. Which is stored in rovers sample storage system. In that it performs some basic analysis of the sample like composition, texture and mineralogy. If it seems interesting it takes few more and perform more detailed examination.*

Drive Train*: It is the system which enables the rover to move on the surface of the object.*

Some rovers used six wheels arranged in a "rocker-bogie" suspension system, which enables the rover to traverse rough terrain. It is designed to maintain contact with the ground all times even when driving over rocks and obstacles. It distribute the weight of the rover evenly across all the six wheels. This allows stability and control while traversing. This system is highly successful in MARS missions. Based on the requirements there are also other suspension systems such as

Leaf Spring Suspension: uses metal plates in shape of leaves stacked of each other to support the weight and able to absorb shocks.

Active Suspension: Active suspension systems use sensors and actuators to adjust the height and stiffness of the wheels in response to changes in terrain. This allows the rover to maintain a level platform and control its motion more precisely.

Manipulator*:*

It is the arm that interact with its environment, and perform tasks.

DOF: it's the degrees of freedom it is how many joints and in how many directions it is able to move and able to collect the more the DOF, better the performance and most of the MARS missions till now contain five degrees of freedom.

A typical manipulator on a planetary rover consists of several components, including joint some joints are given below:

Shoulder Joint: The shoulder joint is the base of the robotic arm and provides the necessary range of motion for the arm to move in different directions.

Elbow Joint: The elbow joint is located near the middle of the arm and provides a second degree of freedom, allowing the arm to bend and reach around obstacles.

Wrist Joint: The wrist joint is located at the end of the arm and provides the final degree of freedom, allowing the arm to rotate and tilt in different directions.

End Effector: The end effector is the tool or instrument attached to the end of the arm that enables the rover to interact with its environment. The end effector may include tools such as drills, scoops, or sample collectors, as well as scientific instruments such as cameras, spectrometers, or microscopes.

Revolute joint: This is a hinge joint that allows rotation around a single axis.

Prismatic joint: This is a sliding joint that allows linear motion along a single axis.

Spherical joint: This is a ball-and-socket joint that allows rotation in multiple directions.

Planar joint: This is a joint that allows motion within a two-dimensional plane.

Universal joint: This is a joint that allows rotation around two perpendicular axes.

The manipulation system will get through variety of sensors including cameras, LIDAR, and other technologies which provide system with information .

The autonomous manipulation system will need to make decisions and plans to achieve its goals the system will be able to interpret the sensory inputs in order to understand its state and use information to generate its next move.

2)Detailed description of COMMUNICATION SYSTEM OF THE ROVER:

I think communication system is the main part of the rover as if it fails no use of the rover even if its able to investigate. So I chose communication system.

It takes only 2.5sec to get communicated with moon, but it takes 11mins to get a message from mars. This is not a small time it makes a huge difference.

This communication happens through signals ,mostly Radio signals one of the electro magnetic radiation which can be transmitted through the vacuum of space. They are used because as they have long wavelength they can be transmitted through long distances without being significantly attenuated, also they can carry different types of information such as data images or commands.

There will be antennas in the space centres (NASA,SHAR) .Then through ground stations we decode the signals and get information. We can also send information or commands like this. Similarly antennas are also located on the rover.

3)*As our rover is literally 33.9 millions of miles its not that easy to communicate through there can be many problems in this the first is*

Delays*: The longer the distance b/w the rover and earth the longer the signal takes to travel back and forth leading communication problematic.*

Interference*: As we have many other signals passing towards the earth it may interfere with our signals leading to weak and distorted or misleading information.*

Limited Bandwidth*: The amount of data that can be transmitted over the communication link is limited by the available bandwidth. This can be a particular challenge when large amounts of data need to be transmitted, such as when sending high-resolution images or scientific data.*

Power *also may be one problem due to low battery levels it may not communicate properly.*

Environmental Constraints*: The solar system doesn't only contain our planets but also some celestial bodies it may be effected due to this.*

4)

Other than only pictures, videos we may use some of the microphones and check the sounds there to detect something new. And we can actually try to plant some seeds in mars using our rover and investigate the growth so that we can observe the nutrition's of plants which can detect if life is possible there or not.

Also as observed in MARTIAN movie we can actually send our astronauts to get on there and live there for some weeks.

5)

The subsystems of a rover are typically interconnected to facilitate the overall operation of the vehicle. The subsystems can include the power system, communication system, mobility system, scientific instruments, and other systems that may be necessary for the specific mission of the rover.

Simplified process of a simple rover would be like:

LAUNCH At first the rover launches

EDL on the martian environment it uses a parachute,shiels and thrusters to slowdown and land saftely.

DEPLOYMENT and then after landing it starts exploring its system such as wheels.

NAVIGATION It uses its wheels to go into the correct location on martian surface then .

SCIENTIFIC DATA COLLECTION using its scientific instruments and drillers it collects data and samples of Martian environment .

DATA PROCESSING after that it analyses the sample and through communication systems it sends back whatever information it has collected.

AUTONOMOUS OPERATION It is programmed to operate autonomously and makes own decisions where to go and collect .

MAINTANANCE it requires periodic maintenance and upgrades, which are performed by mission controllers on Earth.

THANKYOU