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Utilisation of Space Robotics in Making Plans in the Works to Overcome Huge Challenges and Send Humans to Mars By NASA

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Abstract

The study has demonstrated that utilisation of robots and other types of advanced technologies have altered the traditional way of maintaining space projects. The idea of using robots are generally known as Robonauts, which can further help in colonisation process and habitat maintenance in a totally different environment of Mars. NASA has designed a special type of Robots known as "SPHERES", which can work in an autonomous way. Strong computerised program has been established by those scientists to send strong signals at the outer portion of Earth that can further control the movements and activities of Robots. Some issues occur in the handling of Robots at the far away location from Earth, due to the mismatch of commands. Apart from that, high solar flare, dense atmosphere and presence of toxic materials can affect the metal bodies of those Robots and may hamper the exploration activities of those robots. Scientists from NASA have started working on further developing the robots models which can produce oxygen and water from Mars atmosphere. They have aimed to send humans to Mars at least within the year 2050, however before doing this, sending robots in Mars is required for the better outcome of this initiatives.

Keywords

Curiosity, Humanoid Robots, Mars, MOXIE, Navigation, Mars atmosphere, NASA, rover.

INTRODUCTION

The government of the USA has already established an agency for accomplishing scientific activities which are specially related to space and air. The term NASA refers to "the National Aeronautics and Space Administration" and was introduced in 1958. One of the major objectives of that organisation was to conduct research on aeronautics and proceed with the exploration in space. In that case, primarily NASA successfully launched its "Soviet satellite Sputnik" in the year 1957 [1]. The present study is going to shed light on the role of robotics in assisting humans to accomplish their research related activities regarding space. Apart from that, one of the renowned organisations NASA has decided to send robots to Mars to experiment and explore the red planet. The technology driven concept has successfully altered the needs for human beings to conduct experiments, exploration in space and other types of activities. Robotics or utilisation of Robots have altered the traditional way of transportation in space, "orbit maintenance" and exploration in space. Robotics in spaced projects has enabled the unmanned concept of space mission. In order to achieve a mission in space, different scientific fields have been working collaboratively such as computer science, biology, robotics, physics, chemistry and also engineering.

The study will further discuss the current challenges facing NASA to develop the designation of robotics in space missions. One of the major challenging factors is the monitoring and controlling of robotic devices from Earth. The environment of the red planet is much different from the Earth and also unexplored yet. In the case of dissemination of current advancement in space research, scientist from the agency NASA have started to put their best effort on it, to stimulate one of the best futures in space related field, in this regard, it can be stated that, NASA have already launched "Mars Rover Mission" for the exploration purpose to our neighbouring planet Mars. Scientists from that agency have decided to use Robots apart from human beings to find out the signs of life on that planet [2]. That Mars Mission has some high-level goals to seek for the habitable condition on that planet. In that case, another major challenge is to the expedition of Humans to Mars and these technologies such as robotics will successfully evaluate the procedures of colonisation of humans in Mars.

LITERATURE REVIEW

Objectives of the Mars project by NASA

The exploration programme of Mars was launched by NASA in 2020 and the mission was also known as Rover. It can be considered as one of the long-term efforts on the utilisation of robotics in mars project. In 20th Century, one of the major challenges for the scientists from NASA and all over the world, is to send human beings from Earth to a new habitat on Mars. Mars mission also covers some aspects that may help in further exploration of the planet. Robots have already been sent to Mars to find out the variety of rocks which can give those scientists a clue about water [3]. Water is one of the essential components for the sustaining of lives in a totally new environment. Apart from that, those robots

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are responsible for detecting soil , rock, wind , erosion , volcanism, evaporation, cratering and sedimentation processes on Mars. All these factors are necessary for constructing a colony of humans on Mars in the near future.

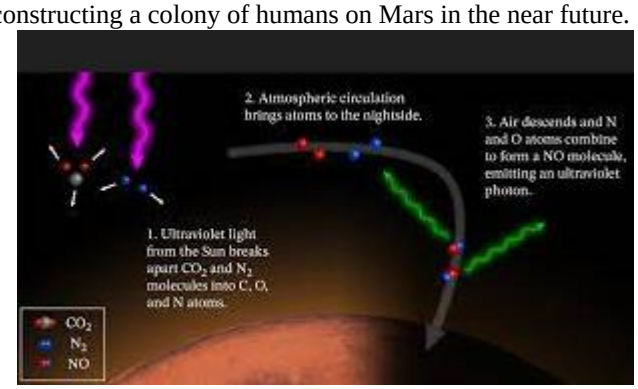

Figure1: NASA Mars Mission
Source: [3]

Therefore, the robot Rover was sent to Mars habitat to collect rock and soil samples from that plant, and also designed in such a way that the rover can successfully return to planet Earth after gathering those samples. On the other hand, robotics is also used in the testing procedure of those samples in the laboratory. These robots have also been used to produce oxygen from the atmosphere on Mars. Apart from that, the space agency NASA have been using robotics in multiple ways such as, transferring huge equipment within spacecraft [4]. Robots are generally worked after setting some commands and these commands are also followed by those robots. Outside environments of Earth are not suitable for Human beings to visit, stay or conduct any activities, hence multiple Astronauts have faced issues while moving in spacecrafts. The utilisation of robotics in Mars mission enables the Rover to collect information from the surface of Mars. Apart from that, utilisation of Robotics provided an opportunity to the scientists of NASA to explore the Solar system further.

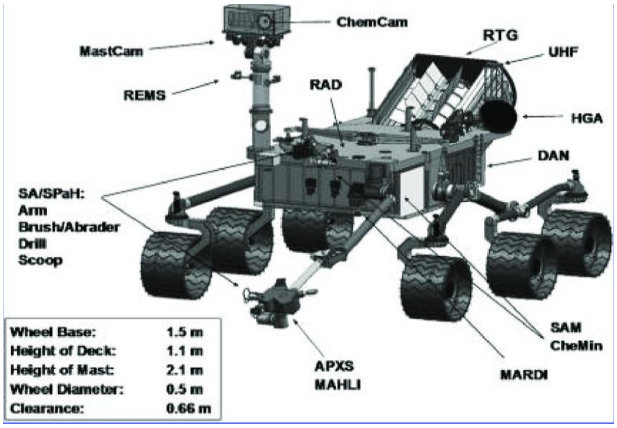

Figure2: Structure of Rover
Source: [4]

Types of robots and technologies used in Mars project

Robotics can be considered as the study and experiments with robots in several fields specially science and technologies. The space organisation NASA have decided to use robotics to accomplish their jobs in different space missions. In 1981, NASA had already utilised Robotic arms in the space shuttle named “Canadarm”. These space shuttles or equipment are also useful for holding Hubble Telescopes and also releasing Rovers on Mars. Primarily, humans were sent to the other parts of our solar system such as Moon or Mars to explore habitat. However, the success rate of those projects was low and then scientists have decided to use robotics to minimise the maximum errors in space missions. The critical mission was conducted by one of the well-known space agencies named NASA with the help of a total 5 types of robots. These robots are known as “spirit”, “Sojourner”, “Curiosity”, “Perseverance” and “opportunity” [5]. All these previously mentioned robots played an essential role in exploring Mars for Human Colonisation, therefore all these robots are known as Rover.

Figure 3: Rover on Mars surface
Source: [5]

Scientists from NASA have decided to send Astronauts to Mars in a later phase to evaluate if the environment is suitable for Human life or not. The launching of Perseverance will help in the Future Mars mission for maintaining safety in case of returning back to Earth. The Astronauts or Scientists are going to use “Nuclear thermal propulsion” for advancing travel systems in deep space [6]. On the other hand, NASA have started to work on developing their Robotics as per their requirements on Mars mission. Those robots are successfully able to assist those astronauts and scientists in Earth and in Space. The concept of using robotics in space missions is also known as Robonaut. These Robonauts can help with different space missions such as, spacewalk, moving wheels of machines at the barren surface of Mars and also within the spacecraft. Additionally, scientists from NASA have introduced another type of small robots named “SPHERES” to use on the surface of mars and also the nearby space stations [7]. The “SPHERES” are generally small types of robots with the spare of soccer balls. In that case, it can be observed that these robots have been designed by scientists to perform in an autonomous manner. Those robots can effectively accomplish their work in a minimal interference from human beings. All these robots contain strong antennas to send and receive signals to Earth or adjacent space stations. Computers or strong systems located at the Earth are generally responsible to send commands to those robots, then they usually follow those commands to complete the work.

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Issues faced by NASA in sending Humans to Mars

The previous studies conducted on the mission Mars and utilisation of Robotics in space , have successfully proven that technologies are best suited equipment for any kind of harsh environment. In the case of exploration in Mars for future perspective, Robotics have facilitated the activities of automation in this field. However, one of the major challenges that scientists by NASA are, the reliability of artificial intelligence in accomplishing their tasks in a totally different environment [8]. The further task reliability issues occur in case of maintaining software in the case of exploration of Space depending on this robotics. Human perspective is highly related to the command system to those robots; hence a mismatch can be observed in the intelligent behaviour of those Robots. For instance, some robots are subjected to detect and search for the unique objects in Mars. Due to the unmatched command, those "Unmanned air vehicles" may miss out the important sight at the time of Mars mission. On the other hand, Connectivity issues are another huge problem that may disrupt the process of gathering information in mars mission.

Figure 4: Artificial design for Human Homes in Mars
Source: [8]

In this context, it can be observed that, the atmosphere of Mars is highly dense and it may take more than 22 minutes to transfer signals between Earth and Mars. On the other hand, the scientific ingenuity required high performance computers for conducting the autonomous navigation system, in that case, Robotics and other technological equipment should be lightweight. However, scientists from NASA have not successfully gathered the knowledge of these cutting-edge technologies. Another issues that affect the exploration in Mars mission is the "On orbit construction" [9]. On the other hand, solar flare present in the outer space region is extremely high, and it may cause solar irradiance for any humans or machines. The volatile situation or Zero gravity in the outer Earth, can be considered as another challenging factor for AI robots [14]. The Mars mission required heavy load transportation handling capabilities to successfully conduct the mission. The weight of those heavy equipment should be carried out after proper calculation and measurements. A lack of measuring the distance between the primary load location and the ultimate destination can lead to disrupting the entire Mars mission. In that case, it can be observed that the total amount of power required for the habitation purpose on Mars is 30-60 KW. On the other hand, the survival of robots in those environments may differ a lot from human resilience. In that case, the scientists from NASA have started the investigation on the needs for robots in the outer Earth environment [10]. In that case, colonisation on Mars may be difficult for humans due to the necessity of "nuclear power generator equipment". Apart from that, Mars habitat, environment and resources are still not enough for the habitation process of human beings in the 20th century.

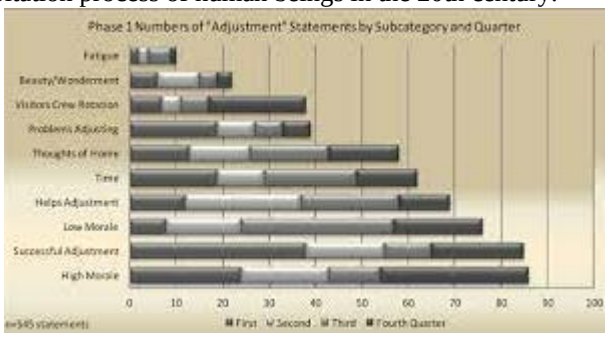

Figure 6: Issues of Mars Mission
Source: [10]

Overcoming strategies through advanced robotics

Mars mission is basically a chain wise project which further deals with innovation. Therefore, every mission depends on the technologies used in previous missions and the scientists from NASA are also focusing on crossing boundaries for further innovation in the Mars project. Scientists from NASA have been paying attention on developing the design of rover, descent and also improving the landing system as well. Sometimes, improper landing can cause serious damage to those robots, therefore smooth landing is necessary for the future Mars project [11]. In order to achieve the best result in Mars exploration some bold and promising technologies are going to be used in Mars missions. In that case, Robots on Mars are going to carry MOXIE with them. MOXIE can be considered as one of the best instruments. That will be adhered with the body of Rover [12].

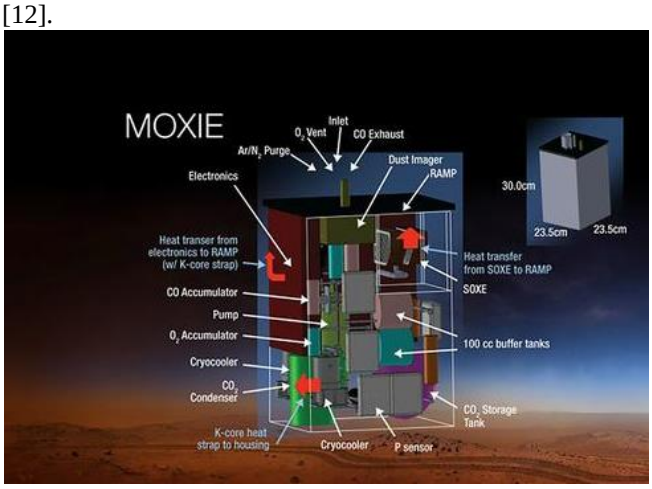

Figure7: Moxie
Source: [11]

The particular technology can easily absorb CO2 from the Martian atmosphere and also convert it into oxygen. It will be

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the best solution for the colonisation of humans on Mars in near future. According to the requirements of Mars atmosphere, the scientists of NASA have started working on developing the "ingenuity Mars Helicopter", which can effectively fly through the hazardous atmosphere on Mars [13]. In order to achieve precisely landing of Rover on Mars, the scientists have introduced "the range trigger technology" which can decrease the area of landing; hence the rover will be closer to the surface of Mars by more than 50%. In this regard, it can be observed that, conducting Navigation in Terrain region of Mars can be more dangerous and it required high performance technologies. In that case, future Mars missions will use "Terrain Relative Navigation" technologies to achieve at least 99% safe landing. Additionally, the Mars perseverance safety needs to be enhanced with an aeroshell and protective capsule.

METHODOLOGY

Methodology can be considered as one of the essential part of any research because it further includes the data collection and data analysis part. In that case, data should be collected from a genuine source of information. For this study, a secondary data collection process should be selected to know the current situation of Mars mission and the improvement in utilisation of space robotics in this mission [15]. Some other sources of secondary data are some government and private websites, journals, Articles and updated web pages. Mars Mission conducted by NASA is naturally a secret mission and individuals from all over the world may not know sufficient information from it. However, scientists from NASA sometimes update lots of information of the current work on their authentic websites.

On the other hand, it can be observed that secondary data is essential for gathering huge amounts of information within a few seconds. In order to maintain the authenticity of the research articles should be chosen from google scholar. Apart from that, the government websites from NASA and its web pages contain lots of updated information related to the Mars Mission [16]. Science and technologies are gradually being updated with the passing time; hence data collectors are required to renovate the data collection process. After collecting data, it should be analysed through observation, deep thinking and knowledge. Mars mission is generally a chain wise or continuous process, hence previous and current data can be observed, examined and compared accordingly. Secondary information are cost effective and time saving, in that case anyone can gather it by the utilisation of the Internet. Apart from that, a proper knowledge regarding technologies can help anyone to analyse it properly. Secondary information can provide the idea of most recently used Robotics and other type of technologies by NASA.

DISCUSSION

The previously mentioned information helps individuals to evaluate that the planet Mars is still not habitable for human being. In that case, one of the fundamental issue is the inappropriate atmosphere of Mars and the Mars pressure is near about 0.6% of Earth. Asv a result, water can not be discovered in a liquid form. Humans or other living organisms can not survive on Mars due to multiple toxic materials present at the surface layer such as perchlorates present at the regolith [17]. On the other hand, Mars magnetic field is not as strong as Earth, hence it can not protect living organisms from solar radiation or flare. Additionally, robots or other equipment can not survive for a long time within these radiation and hazardous environments. Microgravity can be considered as one of the major issues in the Mars project, that muscle and bone weakness can be observed. Therefore, Mars environment is still not suitable for human survival for the long term. Sending human beings from Earth to Mars can be difficult for the scientists of NASA because conceptually it is still out of reach and financially the project is quite expensive. Previously stated information help to demonstrate that exploitation of our neighbouring planet Mars has been fantasised by the Scientists of NASA and all over the world. NASA have already started to examine and evaluate the environmental condition of the red planet Mars with the help of robotics and AI technologies. By the year 2030, that agency is going to send astronauts to a totally new environment 34 million miles away from Earth [18]. According to the report of "American Geophysical Union", water can be found at the beneath layer of the north pole of Mars. NASA have started utilising Robotics and technologies to extract waters from the barren land of Mars . In that case, automated technology such as "Mountaineer Ice Drilling Automated System" can easily detect, map and Drill water from the rocks of Mars. Waters can be considered as one of the essential components for accomplishing the sustainable condition at Mars for Human beings.

NASA have utilised Robotic arms on the perseverance in the Mars mission, which can move exactly like human arms. That robotic arm is almost 7 Foot long and also subdivided into different parts such as "shoulder", "Elbow" and "Joints" [19]. This particular structure can help rovers to move with flexibility to hold things or tools just as humans. Apart from that Automated robot used in Mars mission can drill the surface of that planet through rotary motion. Then the tool will penetrate the surface of rocks in Mars for collecting some precious substances. In this way, scientists from NASA have developed some special robots which can foster the sample acquisition process and also help in analysis of those samples without any error. Apart from that, samples are required to be collected through regolith bits, collection tube, coring and abrader bit. Those robots have been designed with the drilling capacity and a cylindrical drill system can be considered as one of the perfect equipment for breaking down the hard rocks of Martian barren surface. On the other hand, special type of drill system with Robotics has been used to gather loose materials of soils from the surface of Mars within an clean collecting tube. The study also provides a clear concept about the benefactors of using Robots in Space missions rather than human beings. Robots can work more

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effectively and also with the less chances of errors in comparison to human beings [20]. Therefore, robots can explore space more efficiently and also be able to provide essential information about the targeted planet. In case, any fault occurs in the maintenance of robots in a totally new environment, other involved human beings can be safe in this mission. Apart from that , robots can generally tolerate any type of harsh environment or high temperature.

NASA has developed some highly advanced robots such as “Mars rovers”, “Curiosity” and “Perseverance”. Engineers from NASA are still busy with the engineering in building a dynamic variety of new robots that can be further utilised in Mars mission. From this study, people may know about a new type of robot known as “A PUFFER” [21]. One of the major specifically of the robot is exploring and it is generally a short robot with flat folding structure. Within the tight rocky surface of Mrs, this robot can easily fit in and explore. Apart from that, another robot named “ BRUIE” is perfect for exploration in icy surface of Mars, along with taking pictures of different parts of red planet. BRUIE has wheels for moving on ice and it can also easily float on water. Hedgehog is another spike-like robot developed by the scientists from NASA, which can explore small asteroids that pass from the nearby location of Mars. That robot can be placed at the deep creator of Mars and also used in hazardous environment conditions such as Tornado. Moreover, NASA is currently working on developing humanoid robots, which can further assist humans in preparing future settlement on Mars. In that case, the total height of that humanoid robot is 6 feet and weighs 290 pounds, which can work depending on commands based on algorithms. These robots are still in testing phase and one of the best upcoming space robots, developed by the engineers of NASA. Those robots are known as “Valkyrie" or “R5”, that can accomplish their work by themselves along with being helpful for placing humans in the extreme place of any adjacent planet [22]. According to some scientists of NASA it can be observed that, these humanoid robots can effectively replace Astronauts after working in some extreme condition in space. In the future, robots like R5 can arrive successfully before Human being, henceforth they can further collaborate with the crew members of that space mission for building human colonies. One of the major objectives of NASA is to colonise Robots on Mars before sending humans from Earth. When NASA conducts its first humanoid program at Mars, humans may land on the bare surface of the Martian landscape. Therefore, the future colonisation process should be further proceeded with the help of robot workers.

These humanoid robots have been designed in such a way that they can perform dozens of functions for the arrival of humans on Mars at least by the year 2050 [23]. In the year 2019, NASA has already successfully launched its autonomous robot that has already landed on the surface of that planet. Previously used robot in the Mars mission named Curiosity Rover mainly weighs 2200 pounds and NASA have aimed to send more capable robots to Mars. Scientists from NASA also claimed that resources available at Mars are not enough for human colonisation. Therefore, further development in equipment for producing oxygen, Fertilisers, nitrogen, water, ice, co2 are necessary for the growth of crops in the soil of Mars. The Cargo Mission to Mars by NASA also includes the engineering by using the available rock known as Regolith for constructing buildings for future use. The continuous radiation or ultraviolet storm can be inappropriate for human survival, therefore houses on Mars should be domed shaped and thicker. These robots are also well equipped to build such protective barriers for human colonies sent to Mars in the near future.

CONCLUSION

The study has clearly demonstrated the contribution of the USA government on establishing an agency which can deal with scientific activities regarding space. Scientists from “the National Aeronautics and Space Administration” are mainly responsible for exploration in Space, especially focusing on Mars. The agency also focused on using space robots in their Mars mission to experiment with substances found on the red planet.However, main issues can be detected as sending human beings to Mars and helping them to successfully colonise Mars. The study also helps individuals to understand that Rover has already been sent to the surface of Mars to collect soil and rock samples. Scientists from Earth are searching for Water in the deep part of the Martian surface because water is the essential component for life of human beings. Situation of Mars are not favourable for human survival, therefore sending robots at the primary phase can be considered as the best approach taken by NASA. The Mars mission conducted by NASA was structured as a step-by-step process, therefore, first time robotics was used in the mission named “Canadarm” in 1981. NASA has used a total of 5 types of robots for their Mars Mission such as “spirit”, “Sojourner”, “Curiosity”, “Perseverance” and “opportunity”. NASA have started to work on developing their Robotics as per their requirements on Mars mission. Despite all positive aspects, the utilisation of robotics and technologies for Mars mission can be difficult for them. Scientists by NASA are the reliability of artificial intelligence in accomplishing their tasks in a totally different environment. NASA has not successfully gathered the knowledge of these cutting-edge technologies regarding Robotics and navigation systems at the outer portion of Earth.

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