International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 3 Volume No.7 May - June – 2023
DOI:10.46647/ijetms.2023.v07i03.056 ISSN: 2581-4621

# Mars Exploration Perseverance Rover

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**Abstract**
In this paper, the development of chronologies for the mass exploration rover is presented in a nutshell. Over the last twenty years, a "New Space" revolution has quietly unfolded in the domain of space exploration. Previously, only select countries, space agencies, and large industries were able to design, launch, and operate satellites and spacecraft. However, this has changed with the introduction of the "CubeSat" standard in 1999, which has allowed universities and research institutes to join in the space race. In 2013, the commercial Earth Observation sector took off, with two companies launching 100+ CubeSat constellations for optical imaging and weather prediction, featuring very low revisit times. Today, a similar transformation is taking place in the fields of telecommunications and astronomical scientific missions. This chapter reviews the evolution of the space sector up until the arrival of the CubeSats, followed by a discussion of the CubeSat's intrinsic limitations, which are crucial in understanding the development and current status of the CubeSat sector. The strategies of NASA and ESA are also presented. Finally, the chapter concludes with a summary of the technology roadmap required to enable the next generation of CubeSat-based missions, including satellite constellations or federations, formation flying, and synthetic apertures. The work done & presented in this paper is the result of the mini-project work that has been done by the first sem engineering students of the college and as such there is little novelty in it and the references are being taken from various sources from the internet, the paper is being written by the students to test their writing skills in the starting of their engineering career and also to test the presentation skills during their mini-project presentation. The work done & presented in this paper is the report of the assignment / alternate assessment tool as a part and parcel of the academic assignment of the first year subject on nanotechnology & IoT.

**Keywords**
Robot, Mars, Sensor, Space

## Introduction

The Mars 2020 mission, named Mars 2020, deployed the Perseverance rover to explore the Jezero Crater on Mars. The primary objectives of the mission include searching for signs of ancient life and collecting rock and soil samples that could potentially be brought back to Earth. The rover was launched on July 30, 2020, from the Cape Canaveral Air Force Station in Florida and landed on Mars on February 18, 2021. The Perseverance rover is based on the Curiosity rover configuration and is about 10 feet long (excluding the arm), 9 feet wide, and 7 feet tall, making it car-sized. Despite its size, it weighs only 2,260 pounds, less than a compact car. The rover's various components function much like vital organs of a living creature, enabling it to explore and carry out its tasks [1].

The rover has a protective body structure, computers for processing information, temperature controls, and cameras and instruments that provide information about its surroundings. Additionally, it has an extendable arm and hand for collecting rock samples, wheels and legs for mobility, and

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electrical power sources and communication antennas. The Mars Helicopter, which is a technology demonstration, is also part of the mission and hitched a ride on the Perseverance rover. The Mars 2020 mission is expected to last at least one Mars year, which is approximately 687 Earth days. The Fig. 1 gives the design of the sensor used & the characteristic curves [2].

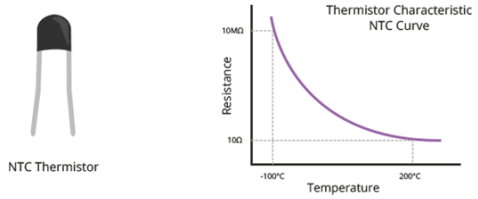


Fig. 1 : Sensor used & the characteristic curves

**Robot Design**

The Perseverance rover is an advanced vehicle designed to explore the surface of Mars, and a replica of the rover has been created using several critical components. One such component is the rocker-bogie suspension, which was developed by NASA in 1988 for use in the Mars rover Sojourner and has since become the preferred design for rovers. This system, along with a differential, enables a six-wheeled vehicle to keep all six wheels in contact with the surface, even on extremely uneven terrain. This suspension arrangement has been used in several Mars missions, including the Mars 2020 rover Perseverance. The Fig. 2 gives the circuit diagram for the mars rover [3].

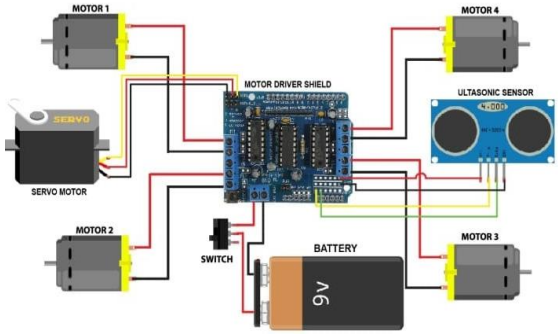


Fig. 2 : Circuit diagram for the mars rover

**Circuit Explanations**

Another crucial component of the replica rover is the DHT11 sensor, which is used to measure temperature and humidity. This sensor is low cost, has a small body size of 15.5mm x 12mm x 5.5mm, and operates on a voltage of 3 to 5V, with a maximum operating current of 2.5mA. The humidity sensing component has two electrodes with a moisture-holding substrate, usually a salt or conductive plastic polymer, in between. As the humidity rises, the substrate absorbs water vapor, releasing ions and decreasing the resistance between the electrodes. This change in resistance is proportional to the humidity, which can be measured to estimate relative humidity. The sensor also has an NTC thermistor for measuring temperature, which is a type of resistor whose resistance varies with temperature. Thermistors are designed so that their resistance changes dramatically with temperature, and the term ‘NTC’ refers to the fact that resistance decreases as temperature rises [4].

In addition to the rocker-bogie suspension and DHT11 sensor, the replica rover also includes an Ultrasonic Sensor and Microcontroller, which are essential for navigation and control. The Ultrasonic Sensor is a non-contact distance measuring module that uses sound waves to detect obstacles and measure distances, while the Microcontroller is a programmable device that serves as the rover's brain, processing sensor data and controlling rover movement. Overall, the replica of the Perseverance rover is a remarkable achievement that demonstrates the complexity of the vehicle's design and highlights the advanced technology required for successful exploration of Mars [5].

DOI:10.46647/ijetms.2023.v07i03.056 ISSN: 2581-4621

**Design of the sensor**

The sensor's functionalities encompass an 8-bit SOIC-14 packaged IC, which processes the analog signal through stored calibration coefficients, converts the analog signal to digital, and provides a digital signal containing temperature and humidity data. The Ultrasonic sensor facilitates distance measurement by using an HC-SR04 ultrasonic distance sensor that incorporates two ultrasonic transducers. One transducer transmits 40 KHz ultrasonic sound pulses as an electrical signal, while the other transducer listens for the transmitted pulses. The receiver generates an output pulse that corresponds to the distance of the object in front, based on the width of the received pulses. This sensor offers non-contact range detection with high accuracy between 2 cm and 400 cm (~13 feet) and operates at 5 volts, making it directly compatible with an Arduino or any other 5V logic microcontroller [6].

**Objectives**

- Investigating various rocks and soils to identify evidence of past water activity, with a focus on samples containing minerals deposited through precipitation, evaporation, sedimentary cementation, or hydrothermal activity [7].
- Mapping the distribution and composition of minerals, rocks, and soils surrounding the landing sites [8].
- Analyzing the geologic processes that have shaped the local terrain and influenced its chemistry, including erosion, sedimentation, hydrothermal mechanisms, volcanism, and cratering [9].
- Conducting calibration and validation of surface observations made by Mars Reconnaissance Orbiter (MRO) instruments to determine the accuracy and effectiveness of various orbiting instruments used for surveying Martian geology [10].
- Searching for iron-containing minerals and identifying the relative amounts of specific mineral types that contain water or were formed in water, such as iron-bearing carbonates [11].
- Characterizing the mineralogy and textures of rocks and soils to determine the processes that created them [12].
- Searching for geological clues to the environmental conditions that existed when liquid water was present [13].
- Assessing whether those environments were suitable for supporting life [14].

**Conclusions**

In this paper, the mini-project work of the mars exploration rover was presented by the first sem engineering students. The work demonstrates how the first semester students had done the project.

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DOI:10.46647/ijetms.2023.v07i03.056 ISSN: 2581-4621

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