VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS), MADURAI – 625009

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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MARS CURIOSITY ROVER

NASA's Mars Science Laboratory (MSL) mission

November 26, 2011

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Artificial Intelligence

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INTRODUCTION

Curiosity, U.S. robotic vehicle, designed to explore the surface of Mars, which determined that Mars was once capable of supporting life. The rover was launched by an Atlas V rocket from Cape Canaveral, Florida, on November 26, 2011, and landed in Gale crater on Mars on August 6, 2012.

Curiosity is about 3 meters (10 feet) long and weighs about 900 kg (2,000 pounds), which makes it the longest and heaviest rover on Mars. (By contrast, the Mars Exploration Rovers, Spirit and Opportunity, are 1.6 meters [5.2 feet] long and weigh 174 kg [384 pounds].) Unlike previous rovers, Curiosity did not have its landing cushioned by air bags; rather, because of its large size, it was lowered to the surface by three tethers from the spacecraft's body, called the sky crane.

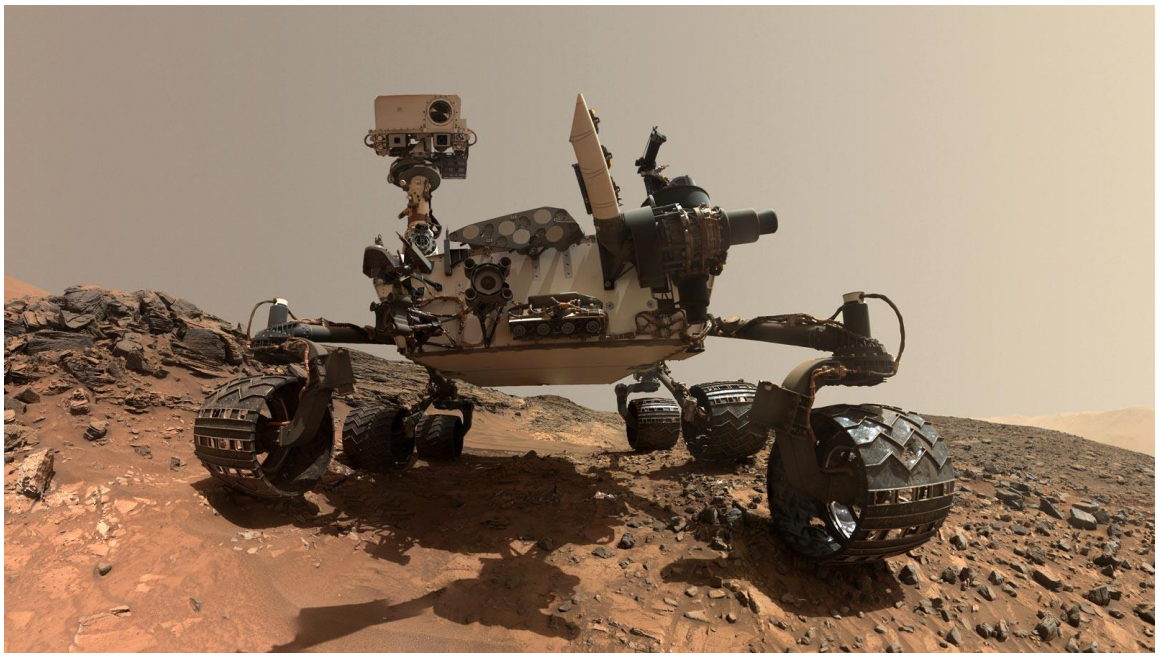
GOALS AND OBJECTIVES

As established by the Mars Exploration Program, the main scientific goals of the MSL mission are to help determine whether Mars could ever have supported life, as well as determining the role of water, and to study the climate and geology of Mars. The mission results will also help prepare for human exploration. To contribute to these goals, MSL has eight main scientific objectives.

Biological:

1. Determine the nature and inventory of organic carbon compounds
2. Investigate the chemical building blocks of life (carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulphur)
3. Identify features that may represent the effects of biological processes (biosignatures and biomolecules)

MARS CURIOSITY ROVER



Geological and geochemical

4. Investigate the chemical, isotopic, and mineralogical composition of the Martian surface and near-surface geological materials
5. Interpret the processes that have formed and modified rocks and soils

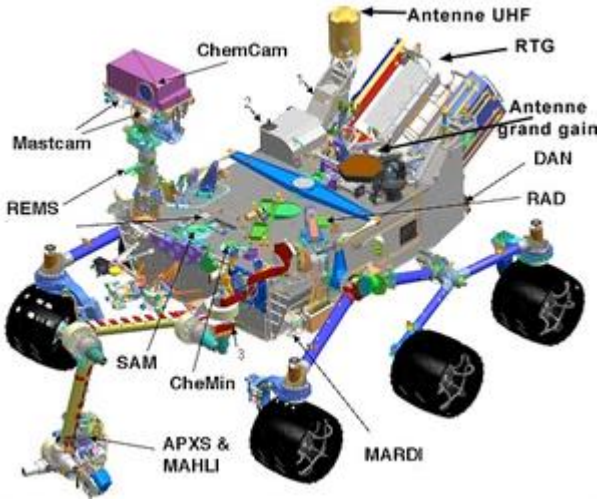
Planetary process

6. Assess long-timescale (i.e., 4-billion-year) Martian atmospheric evolution processes
7. Determine present state, distribution, and cycling of water and carbon dioxide

Surface radiation

8. Characterize the broad spectrum of surface radiation, including galactic and cosmic radiation, solar proton events and secondary neutrons. As part of its exploration, it also measured the radiation exposure in the interior of the spacecraft as it travelled to Mars, and it is continuing radiation measurements as it explores the surface of Mars. This data would be important for a future crewed mission.

DEVICES AND SPECIFICATIONS OF ROVER



MARS CURIOSITY ROVER

SPECIFICATION OF ROVER

Curiosity, being the size of a car, weighs in at 3893 Kilograms. The rover is powered by a radioisotope thermometric generator (RTG) which produces energy from the decay of radioactive isotopes, such as plutonium. The resulting heat from the decay is made into electricity by thermocouples. This is an improvement from the last rovers, which utilized sun power through solar panels, which was intimately the downfall of one and a hindrance to both.

The rover has two on-board computers, called Rover Compute Elements. These computers run VxWorks, a real time operating system built from the ground up, even having its own kernel. The Memory on the computers includes 256 kB (kilobytes) of Electrically Erasable Programmable Read-only memory (EEPROM), 256 MB (Megabytes) of DRAM (Dynamic Random Access Memory) and 2 GB (Gigabytes) of flash memory. All of the memory is radiation hardened to prevent radiation damage. They also feature a single core RAD750 processors, which are radiation hardened processors capable of handling 400 MIPS (Millions of instructions per second) The rover is fitted with two computers as one of them serves as a backup, which was utilized when in February 28, 2013, an issue occurred in the flash memory of the first computer causing the computer to boot continuously in a loop, forcing NASA to use the backup. These computers are responsible for self-monitoring to keep the rover operational, such as measuring temperatures They are also responsible for taking pictures, driving, and operating the instruments

DISCOVERIES

The Rover has contributed to many discoveries, including identifying high amounts of radiation on Mars. From the results, NASA states astronauts could tolerate the radiation for a long-term mission to Mars without accumulating high doses of radiation. The rover also managed to discover evidence supporting the idea that Mars could have once had a lake with neutral pH, not being too salty. Scientists believe this is because Mars may have once had a thick and dense atmosphere, trapping heat. The atmosphere Mars has today is not strong enough to hold much heat, causing low temperatures. This is because a sample drilled from a John Klein rock contained Clay minerals, suggesting an aqueous environment. Many key chemical ingredients for life have been found in rock sampled drilled from the planet, including nitrogen, sulfur, hydrogen, oxygen and phosphorus. Other chemical ingredients such as benzene and propane have also been discovered. Temperatures averages of negative 60 degrees to negative 125 degrees Celsius have also been observed. Large spikes of methane with concentrations of 21 parts per billion have also been discovered on Mars, with no clear source, except that it occurs in an unknown seasonal pattern. This is small compared to earth's air sample containing 1865ppb of methane. The source is not even known if it's biological, geological, or even ancient or modern.

CONCLUSION

The Mars rover Curiosity overall was a major success, making many discoveries and serving as the basis of the 2020 rover, and being one of the top most successful rovers sent to Mars. The rover is not only a pathway to future discoveries and development, but a testament to the technological achievements of today. The rover has made many fascinating discoveries, and will continue to do so.

REFERENCE

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