Advanced Design for Robot in Mars Exploration

P. Pradeep, M. Prabhakaran, B. Prakash, P. Arun Kumar and G. Gopu
Department of Electronics and Instrumentation Engineering
Sri Ramakrishna Engineering College
Coimbatore-641022, Tamilnadu, India

Abstract

Mars Planet Exploration requires a new design of robot to explore it in a new way. This robot has been equipped with specially designed wheels to overcome all possible obstacles. In other words it helps to explore the unknown land in the mars especially the craters. This robot has a special type of plates mounted on the wheels, which can pass over all obstacles, especially suited for mars. The instruments inside the robot will be protected by suspension system in wheels. It can extend the life time of the Robot, saves instruments in it from physical damage. This robot will be having a extra setup to explore craters. Since DTMF technique has high coverage area as per service provider it helps this robot to be used in the field of military and forest application. It is first time using a mobile phone to control a robot with 3G technology.

Keywords
Specially designed wheels, Extra setup, Mars, DTMF, 3G Technology

1. Introduction
The robot that had been sent to space still now has suffered a lot in overcoming obstacles like stones on the path. So they decided to avoid the obstacles by taking different path or route. This methodology worked for several areas in MARS but not for the craters and other rough terrain surface. Our aim deals with this problem. We have designed a robot whose wheels can overcome all types of obstacles and an extra wheel setup to explore craters. Also this paper would be a fundamental, to design a Rover Robot for the upcoming missions like CHANDRAYAAN-2 and MARS Robot by ISRO.

2. Specially Designed Wheels
The specially designed six wheels help in overcoming obstacles in terrain surface. The Rover Robot has six specially designed wheels. The structure of wheels is shown in the figure 1, it consist of has 1)six wheels, 1 A)suspension system, 2)additional wheel setup, 3)dish to transmit and receive signals, 4)antennas, 5)four cameras, 6)extendable arm 7)scientific instrument. The wheel has a plate like erected arrangement which supports the robot in overcoming obstacles. It can cross the stones of height equal to the wheel height. The wheel has a diameter of 30cm. The height of the plate is 7cm and the width is 5cm. Each wheel has its own individual motor attached to it. The speed of the robot is 1inch/sec. using this type of wheels it is easier to explore the rocky or rough terrain surfaces in MARS.

3. Exploring the Crater Using Extra Setup
The additional wheel setup is to explore the craters or deep trenches. The cameras are used to view the surface. Let us see another important work of our Robot in exploring the crater. Crater is a bowl-shaped cavity or hollow shaped cavity in the surface of the planet caused by impact. It ranges from meters to miles however we focus on exploring the craters up to 1000 meters deep. Normally a Robot cannot enter this deep crater as its fall causes damage to the robot. So still now they are left unexplored. In our design we have a special setup to use in that situation. This setup has two wheels, a spoon to take samples and rope tied to the extra setup which can be elongated as well as shrinked as shown in figure 2, it consist as follows 1)plates, 2)spoon, 3)rope, 4)two separate motors.. The other end is attached to motor which rewinds and forwards the rope by moving motor clockwise and anticlockwise direction. The zoom section of wheel is shown in figure 3

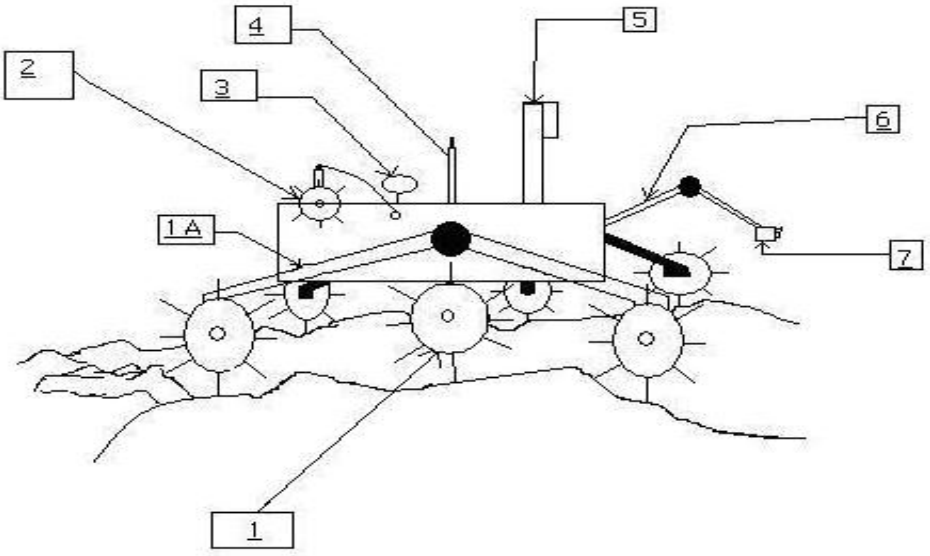

Figure 1: Structure of our Rover Robot for Mars Application

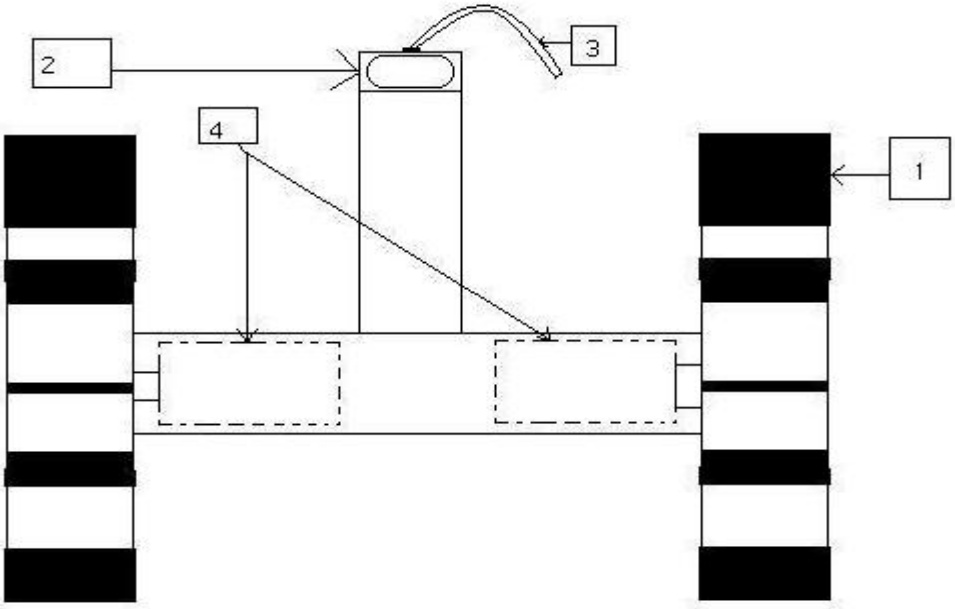

Figure 2: Structure of Extra Wheel Setup to explore Craters

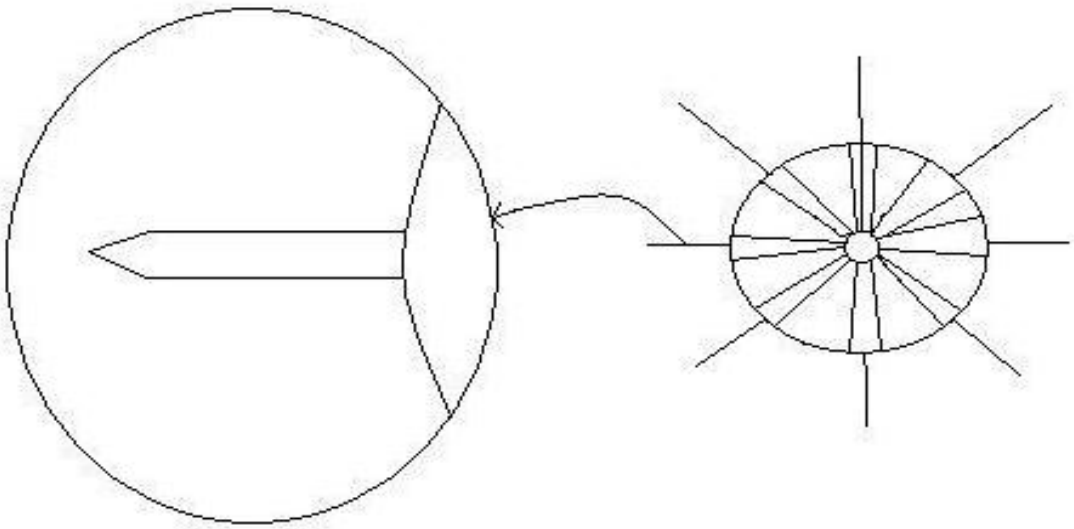

Figure 3: Zoom section of Wheels

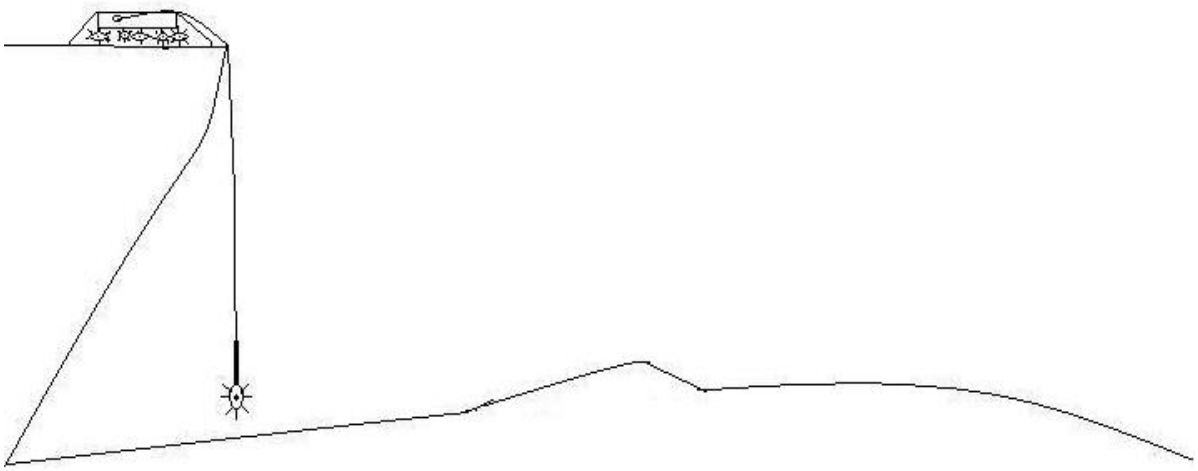

Figure 4: Demonstration of Working of Extra Setup in a Crater

3.1 Materials used to make rope

The rope has a length of 1000 meters, it is made up of zylon which is very thin and strong. As the zylon is light weight it suits for space application. Inside the zylon material small thin wires are there, as the control signal flows from Rover Robot to extra wheel setup through the wires

3.2 Working of Extra Setup

The Robot comes to rest and the extra wheel setup starts moving from the Robot. It gets down to the land and goes inside the Crater with the help of the rope which extends. This wheel setup has two separate motors on either side. It helps the setup to turn in all direction by halting one motor and running the other. It has a camera in it to view the front surface of the setup. This is a additional weight in Robot but it plays a major role in exploring the craters. The demonstration is shown in figure 4.

4. Scientific Instruments Used

The scientific instrument which we use here is already used by Spirit1 and Opportunity2 (NASA missions). The Panoramic Camera (Pancam), for determining the texture, color, minerology and structure of the local terrain. Navigation Camera (Navcam) that has higher field of view but lower resolution and is monochromatic, for navigation and driving. Alpha particle X-Ray Spectrometer (APXS) is used for close-up analysis of the abundances of elements that make up rocks and soils. Magnets for collecting magnetic dust particles.

5. Use of Poles

The Poles used here is to support the Robot, when it faces a critical situation like tough obstacles. Pole is a long, a radio antenna like structure which extends when needed. It has a motor at its end to dig into surface to have strong support. There are two poles, one in front and the other in back of the Robot. It is also used when the additional Rover setup is used. To explain further when the additional setup moves the Robot should remain in rest state without moving. The working of poles is explained in the Figure 4.

6. Communication

The rover has a low-gain and a high-gain antenna. The low-gain antenna is omni directional, and transmits data at a low rate to Deep Space Network (DSN) antennas on Earth. The high-gain antenna is directional and steerable, and can transmit data to Earth at a higher rate. The rovers also use the low-gain antennas to communicate with spacecraft orbiting Mars. The orbiters relay data from and to Earth; most data to Earth is relayed through orbiters. The benefits of using the orbiters are that they are closer to the rovers than the antennas on Earth, and have view of Earth for much longer than the rovers. The orbiters communicate with the rovers using UHF antennas, which have shorter range than the low and high-gain antennas.

7. Use of Robot in Military Application

As our Robot can move in any improper surfaces it can also be used in the field of Military and the forest applications as shown in figure 5. In war fields normally tank moves forward only if, it gets clearance signal from the aircrafts or sometimes from soldiers in the front. During this process many lives has been lost. If we use our Rover just by adding an explosive detector and a high resolution camera, it will be sent in front of solider and can be used for getting clear view of wheel happening in front.

8. Use of Robot in Forest Application

In forest many illegal activities like poaching, deforestation, smuggling has been carried on, to prevent and to locate animals, take samples of saplings, water. Our Robot can be used as a informer. In this application we can add a pick and place arm which will be suitable to take samples and it also needs a high resolution camera.

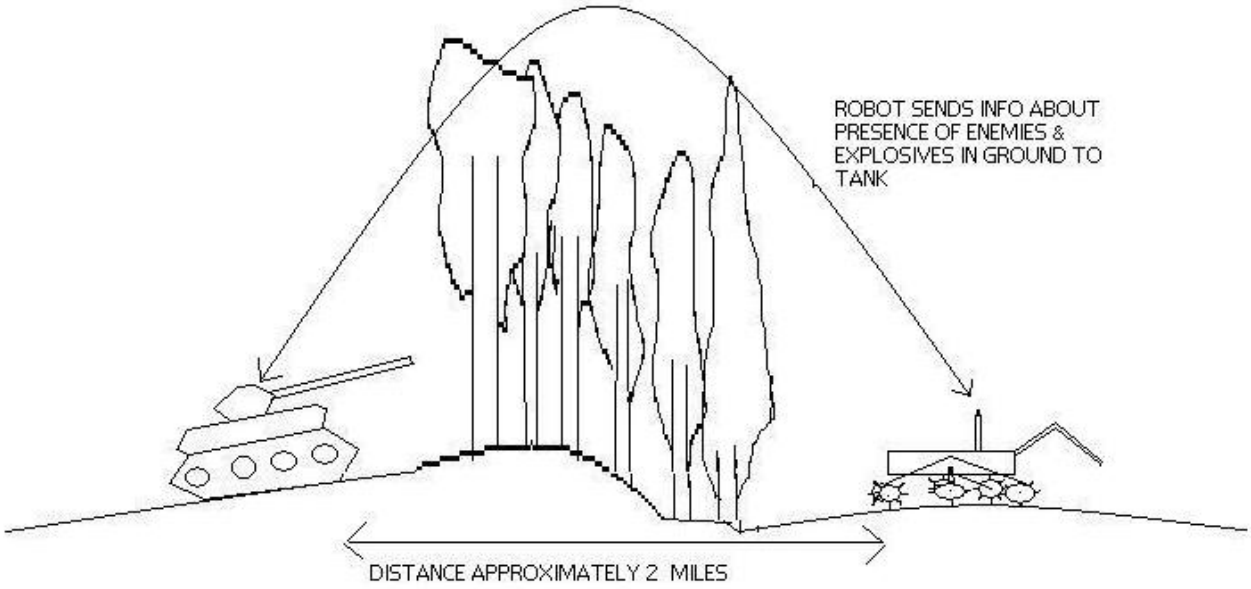

Figure 5: Application in Military Field

9. DTMF Technology for This Application

DTMF is nothing but a touch tone which is heard when a button is pressed in our mobile phones. In the application of Military and forest departments there is no need to implement path finder technique, instead we go for a manual control by DTMF technique. RF control has a drawback of short coverage area, limited controls. To avoid this we go for DTMF technique which has high coverage area as per service provider, twelve controls are possible.DTMF is nothing but a touch tone which is heard when a button is pressed in our mobile phones. For the first time we make use of a mobile phones to control a robots.

There are two mobile phones one act as a remote and the other act as a receiver which is mounted on the Robot. Each button in the mobile phone has a low frequency and high frequency, which will be added together and sent to the other end. The DTMF tone is decoded by using a DTMF decoder which converts DTMF tones in to a binary code. According to the actions needed, we write a C program and compile to convert as a hexadecimal code. This hexadecimal code is burnt in to Microcontroller. The purpose of Microcontroller is to control all the motors in the Robot. The Microcontroller satisfies this by a motor driver IC connected in between Microcontroller and motors of the Robot.

10. 3G Technology for This Application

To continuously monitor the movements of Robots and work area we use the available 3G technology. 3G is the advanced technology in the communication field, which will transfer the voice and streaming videos simultaneously. That is a mobile with 3G technology option is used at both ends. One is placed in the Robot and other is used as a monitor. A camera with a transmitter circuit can transmit video only to a short distance. To avoid this we go for 3G technology. Even the GPS option in the mobile phones can be used to locate the Robot around 500meter to 1meter accuracy.

11. Conclusion

Our Space Rover Robot wheels are capable of overcoming all possible obstacle especially suited for the planet MARS. It explores any terrain surface and craters which are still unexplored in MARS and other planets. It can extend the life time of the Robot, by saving instrument from physical damage. It can also be applied for forest and Military departments. The working model is being constructed, it will be ready in the middle of December.

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