

A REVIEW PAPER ON MINI MARS ROVER

Mr.Md.Azeem, K.Vinod Kumar, Bejgam Rithish, Guguloth Sai, Maddela Deepak

Mr.Md.Azeem, Assistant Professor, Mechanical&GNIT

K.Vinod Kumar, Student, Mechanical & GNIT

Bejgam Rithish, Student, Mechanical & GNIT

Guguloth Sai, Student, Mechanical & GNIT

Maddela Deepak, Student, Mechanical & GNIT

Department of Mechanical Engineering, Guru Nanak Institute of Technology, Hyderabad

ABSTRACT: The rocker-bogie suspension mechanism it's presently NASA's favoured style for wheeled mobile robots, primarily as a result of its sturdy capabilities to upset obstacles and since it uniformly distributes the payload over its six wheels in any respect times. although it's several benefits once handling obstacles, there's one major defect that is its low average speed of operation, creating the rocker-bogie system not appropriate for things wherever high-speed traversal hard-flat surfaces square measure required to hide massive areas in brief periods of your time, principally thanks to stability issues. Our proposal is to extend the soundness of the rocker-bogie system by increasing its support plane figure, creating it additional stable and flexible whereas moving at high speed, however keeping its original robust sizes against obstacles. The Rocker-Bogie quality system was designed to be used at slow speeds. It's capable of overcoming obstacles that square measure on the order of the dimensions of a wheel. However, once surmounting a large obstacle, the vehicles motion effectively stops whereas the front wheel climbs the obstacle. once operational at low speed (greater than 10cm/second), dynamic shocks square measure reduced once this happens. for several future planetary missions, rovers can ought to operate at human level speeds (-1m/second), Shocks ensuing from the impact of the front wheel against associate degree obstacle might injury the

payload or the vehicle. we are going to develop methodology/away/a technique} of driving a rocker-bogie vehicle in order that it will effectively step over most obstacles instead of impacting and rising over them Most or the advantages of this method is achieved with none mechanical modification to existing styles solely a amendment au fait strategy. Some mechanical changes square measure recommended assembling the utmost profit and greatly increasing the effective operational speed of future rovers.

1.INTRODUCTION

The Mars Rover could be a vehicle that has been designed to traverse the rugged terrains of Mars and collect samples of assorted things on Mar's surface. Scientists over the years have tried to explore the chance of life on Mars. Such explorations are largely done victimization rovers. Therefore rovers ought to be specially designed to traverse all types of terrains and should be equipped with state of the art technology. A typical style part is most rovers over the years is that the rocker bogie mechanism. The rocker bogie mechanism has quite a ton of benefits and is therefore a well-established mechanism. The most advantage is that it ensures that every wheel to be in-tuned with the bottom in the slightest degree times. This advantage is vital to making a stable all tract system. Consequently the traction of the

rocker bogie provides is equal and reliable permitting a sleek running even on the uneven terrains [12].

The earliest notable Mars mortal, the guide, landed on Mars with a totally operate rover on Mars on July 4, 1997. The rover carried a large array of scientific instruments to research the Martian atmosphere, climate, earth science and its rock and soil composition. Sojourner, the Pathfinder's rover, created observations that answered various questions about the origin of the rocks and different deposits on Mars. Following its role, the chance with success investigated soil and rock samples and managed to require broad pictures of its landing web site} giving US valuable info regarding the Martian parcel and different site conditions. it's the info that was collected in these missions, victimisation sampling technology, that allowed scientists at NASA to theorize regarding the presence of haematite and think about exploring the chance of finding water on the surface of Mars. Curiosity, another historic milestone within the history of alien planet exploration, was allotted the role of investigation Martian climate and earth science. It assessed whether or not the chosen field web site, wind Crater, had ever offered environmental conditions favourable for microbe life and future investigated the role of water in planetary habitability as preparation for future human exploration [1-4]. In these styles of rover's solely 6-wheeled rocker bogie [5-12] suspension is employed [12].

2. LITERATURE SURVEY:

2.1 NEED AND MOTIVATION FOR THE SELECTION OF THE PROJECT:

One of the most scientific drivers of the exploration of Mars is that the hunt for signs of life, past 72years and gift, on or close to the surface. Mars rovers play a vital role within the Mars exploration. they will replace humans in implementing the exploration mission within the advanced and unstructured environments [1], and weigh down the value of exploration. Thus, it's the foremost direct and effective thanks to explore Mars [2,3]. The rovers that have

capabilities of autonomous roving and exploring, might travel many hundred meters even many tens of kilometres on the surface of Mars. and also the rovers would like implement easy explorations on the surface of Mars with the scientific instruments. Seven years once the Mars guide mission, the 2 Mars Exploration Rovers can give a big advance in our robotic and science instrument capability on Mars. The Mars Exploration Rover (MER) mission also will like a way higher understanding of Mars and a regional geological context of the landing sites, ensuing from the analysis of knowledge from Mars world Surveyor and Mars Odyssey. every rover are going to be capable of driving a minimum of 600 m throughout its expected 90-sol minimum period and can acquire visible and infrared multispectral panoramas from many separate locations within the locality of every landing web site. A "sol" is one Martian day, that is some twenty four hours and forty minutes long. These panoramas can permit the science team to characterize and map the range of rock and soil sorts at every landing web site and to pick out representative and scientifically promising samples for close-up examination with the instruments on the rover's robotic arms. The MERs can give a lot of advanced "ground truth" than what was obtained at the guide landing web site, for 2 new locations which will be tied to existing and future orbital remote-sensing information sets.[4]

2.2 TYPES OF ROVERS:

1. Early Mars Rovers:
 - a. Viking on Loop Wheels (1979)
 - b. Marsokhod (1980's)
 - c. Robby 1990
 - d. Rocky 3 (1990)
2. Birth of Micro rovers:
 - a. Rocky 8 (2000)
3. Sojourner and the Mars Exploration Rovers
 - a. Mars Exploration Rover (2003)
4. Mars science Laboratory Rover

a. Mars Science Laboratory Rover, 2003

2.3 HISTORY OF ROVER:

While humans have nonetheless to journey in-person to Mars, independent agency many rovers to drive around and explore the terrestrial planet for North American nation. A rover will take photos, perform experiments, and travel across the rocky parcel of land of Mars (this last half is what sets rovers with the exception of landers, that do all of their add the place they landed). Since 1996, independent agency has with success landed a complete of five rovers on Mars, and a pair of those area unit still operative these days. These independent agency missions every have a spread of objectives, however all of the rovers are accustomed assess the potential for ancient environments for all times, together with by searching for proof of liquid water within the Martian past. Over time, these rovers became ever a lot of advanced, carrying a series of high-end instruments to explore Mars. The progression of NASA's Mars rovers, whereas short, is actually a stimulating journey. Much of area exploration is divided into 3 categories: an enquiry to higher perceive our universe, interest, and economic potential in victimization natural resources outside our planet, and also the future establishment of extra-terrestrial bodies. moreover, most interest has been in our moon and Mars, as these planetary bodies area unit obtainable, and have environments that area unit hospitable enough for rovers, and doubtless for future establishment. The moon is additionally all right fitted to scientific instrumentation like radio observatories or IR telescopes, because it has no atmosphere, instruments like these will live signals that may preferably be disturbed or eliminated on Earth. Interest in Mars largely relates to increasing our data of the world, specifically with relevance its ability to support an individual's colony. Learning additional regarding the composition of its atmosphere and soil will tell USA whether or not the mars may doubtless support microorganism life.[7]

2.3.1 SOJOURNER:



Fig 1: Sojourner rover

The first rover on Mars was a district of the guide mission. The rover, named occupant, landed in July 1997 at Ares Vallis victimisation associate airbag to cushion the autumn. This 1st rover was equipped with associate x-ray mass spectrometer and several other cameras. The cameras showed pictures of rounded pebbles and cobbles upon landing, proof for the bottom breaking discovery that there was possible once stable liquid water on Mars. The rover determined several mud devils furthermore. The mission lasted well-past its supposed length of 1 week however finished many months later in September 1997, creating it the shortest rover mission.[8]

2.3.2 SPIRIT AND OPPORTUNITY:

The next rovers to Mars were a part of a cooperative mission and square measure called the Mars Exploration Rovers (MERS). the 2 MER robots, Spirit and chance, landed on Mars in 2004.



Fig 2: Spirit rover



Fig 3: Opportunity rover

They touched down on opposite sides of the world at Gusev Crater and Meridiani Planum victimisation airbags to cushion their fall, very similar to the guide mission. These rovers were equipped with cameras, many varieties of spectrometers, rock abrasion tools, and magnet arrays. The intent of the first 90-day mission plans for each of them was to analyze the presence of water and higher perceive the climate of Mars. The results from this mission have junction rectifier some scientists to believe life could are capable of living on Mars at just once. one among their discoveries was the presence of clay minerals that fashioned in neutral hydrogen ion concentration waters. They additionally found extra, reinforcing proof that Mars once had liquid water at its surface together with the presence of iron ore, a mineral typically fashioned within the presence of water. Another mineral discovered was jarosite, that solely forms in acidic water, that on earth will sustain some a lot of extreme styles of life. These rovers lasted gone their meant 90-days: Spirit was operating for over half-dozen years before losing communications. chance created it over double as long, lasting till 2018 before a sandstorm caused it to lose communication with Earth[8].

2.3.3 CURIOSITY:



Fig 4: Curiosity rover

While chance was still roving around Mars, National Aeronautics and Space Administration launched the Curiosity rover in late 2011. It found out Mars in current of air Crater and, in contrast to previous rovers, Curiosity used a parachute to assist considerably slow the descent and assist with the landing. Once on Mars in current of air Crater, the rover began utilizing its big variety of instruments on board to explore the earth science and chemical history of the region. Curiosity is provided with cameras, spectrometers, radiation detectors, and environmental and atmospherical sensors. These instruments have allowed this rover to form a number of the largest discoveries concerning the Mars, particularly relevant to its earth science history. Sample Analysis at Mars (SAM) is associate degree instrument that discovered proof for organic carbon in a number of the rocks of Mount Sharp, a central mountain at intervals the crater. The radiation detectors on board conjointly found the radiation levels on Mars from galactic cosmic rays and alternative energy particles might cause damaging health effects to future astronauts. This rover remains operating nowadays driving on Mount Sharp from a clay-rich region to a sulfate-rich region, and that we expect to seeing what new discoveries it makes.[8]

2.3.4 PERSEVERANCE:

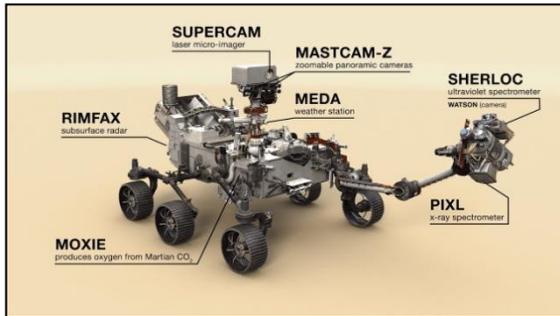


Fig 5: Perseverance rover

Perseverance is that the latest rover sent by National Aeronautics and Space Administration. Perseverance launched in 2020 and touched down on Mars simply this Gregorian calendar month. Perseverance comes together with another new exploration device, a heavier-than-air craft named Ingenuity. Among the goals of this rover square measure to seem for signs of ancient life (the initial mission to try to therefore since the Viking Landers) and to start the method of returning samples of Martian rocks to Earth. These would be the primary came back samples from another planet in our system. Perseverance hasn't had abundant time on Mars however it's absolute to build some nice findings with its suite of latest instruments. a number of these instruments include: the Mars Environmental Dynamics instrument used for measurement weather patterns, measuring system radio detection and ranging|radiolocation|measuringinstrument|measuring system [measuring device} Imager for Mars belowground Experiment that may be a ground-penetrating radar, and SHERLOC (Scanning liveable Environments with Raman & Luminescence for Organics & Chemicals) for distinctive organics and bio signatures. The foremost distinctive instrument aboard Perseverance is that the Mars O ISRU Experiment, conjointly called guts. Guts are functioning to supply O from the greenhouse emission gift within the atmosphere of Mars. Perseverance has the longest original mission length of 1 Mars year, regarding a pair of Earth years [8].

There are still tons to be told concerning Mars and its history. Rovers are a number of the simplest technologies out there for aggregation info concerning extra-terrestrial objects that humans have however to go to. Rovers have solely been around for a brief amount of your time, and there are a restricted variety of rovers to go to Mars. Future rovers with a lot of advanced technology could even come back a number of the simplest information for responsive the question: is/was there life outside of Earth [8].

2.4 COMPONENTS OF MARS ROVER:

2.4.1 CAMERA:

Introduction

The NASA Mars Exploration Rover (MER) mission can land a combine of rovers on the surface of Mars in 2004. The rovers square measure designed to draw close to 600 m across the Martian surface over the 90-Martian unit of time (sol) mission. The MER mission represents a major advance in our ability to explore Mars. Technological advances in physics, detectors, and packaging have considerably reduced the mass and power usage of remote sensing instruments relative to previous Mars-landed missions. The MER cameras weigh[5]

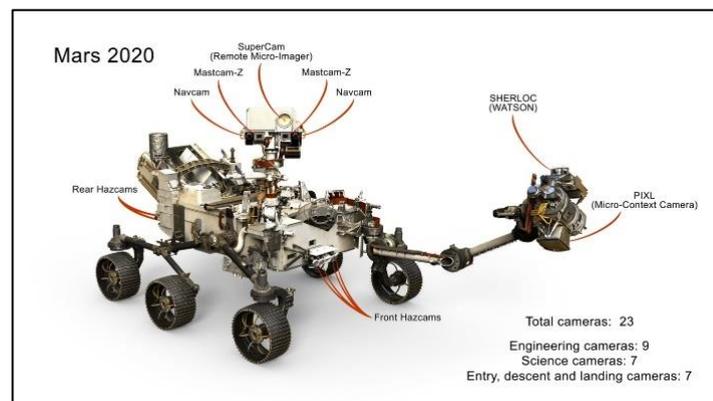


Fig 6: Mars rover components

Mechanism used for camera performance:

A pan and tilt mechanism for a police work camera that may pan through 2 full revolutions. A bell crank has one arm within the path of rotation of a tray of switches, and therefore

the bell crank is shifted to increase the alternative arm. every arm is shifted by one switch, however can actuate the opposite switch to reverse the pan motor[5].

Each MER camera consists of 2 mechanical housings: a detector head associate degreed an natural philosophy box. The detector head contains associate degree lens system assembly and a charge-coupled device (CCD) detector. The natural philosophy box contains the CCD driver natural philosophy, a 12-bit analog-to digital device (ADC), and also the camera/rover interface natural philosophy. Hardware commands area unit received associate degreed sent exploitation an Actel RT 1280 Field Programmable Gate Array (FPGA), that communicates to the rover natural philosophy via a high-speed serial low-tension differential signal (LVDS) interface. The camera natural philosophy box additionally contains a heater electrical device that warms up the natural philosophy to on top of the minimum operational temperature of 55C. as a result of the detector head is thermally isolated from the natural philosophy box, the camera natural philosophy is heated while not considerably warming the detector head, that helps to stay thermally elicited CCD dark current to a minimum. The natural philosophy boxes and detector head area unit connected through a flex cable, and also the cameras area unit connected to the rover interface natural philosophy exploitation impedance-matched cables. The rover provides offer voltages of +7 V and ten V to the cameras. Every MER camera natural philosophy box is hardwired with a singular eight-bit electronic serial variety that identifies the camera [5].

Table 1. Summary of Engineering Camera Functional Requirements

Cameras (number per rover)	Requirements
Descent camera (1)	Acquire 3 images of the Martian surface between altitudes of 2000 m and 1200 m during descent; field of view: 45, 3-m pixel spatial resolution; broadband, visible filter.
Navcams (2)	Provide terrain context for traverse planning and Pancam, Mini-TES pointing; 360 field of regard at
Hazcams (4)	Provide image data for the onboard detection of navigation hazards during a traverse; provide terrain context immediately forward and aft of the rover (in particular the area not viewable by the Navcams) for traverse planning; support Instrument Deployment Device (IDD) operations; support rover fine positioning near IDD targets; wide field of view (120), 2 mrad/pixel angular resolution; stereo ranging immediately in front of the rover (10 cm stereo baseline) to an accuracy of ± 5 mm; broadband, visible filter.

2.4.2 SENSORS:

1. Metal detection sensor



Fig 7: Metal detection Sensor

Types of Metal detection Sensors

- a. Walk-through Metal Detection Sensor
- b. Hand-Carried Metal Detection Sensor
- c. Gradiometer Metal Detection Sensor

2. Water detection Sensor

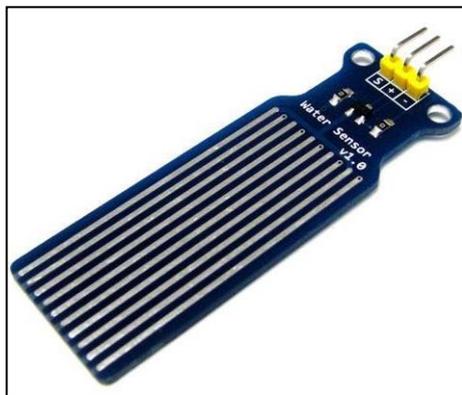


Fig 8: Water detection sensor

Water sensor brick is designed for water detection, which can be widely used in sensing rainfall, water level, and even liquid leakage. Connecting a water sensor to an Arduino is a great way to detect a leak, spill, flood, rain, etc. It can be used to detect the presence, the level, the volume and/or the absence of water

3. Soil Color detection Sensor

Sensor’s area unit what the automaton uses to collect information regarding the planet around it. Cameras and bit sensors area unit quite common, however some robots use temperature, humidity, or even hydrogen ion concentration sensors. The smoke detector put in in your home uses a carbon-monoxide sensor to work out if there's a hearth within the house. Some sensors area unit a touch additional mundane, however no minor. The switch that controls your white goods light-weight, mounted within the door, could be a device that detects the state of the door (open or closed). A sensor, by itself, will nothing however offer information. it's up to alternative components of the automaton to actually do one thing thereupon information[11].

2.4.3 MOTOR: A motor is a devise used to convert electrical energy into mechanical energy to produce useful work



Fig 9: Motor

Maxon motors also will be used for waterproofing and depositing the sample containers. NASA's reaction propulsion Laboratory (JPL), charged with concluding the mission, asked Maxon to provide ten drives for the rover. like the majority previous Mars missions, these drives are supported customary product from Maxon’s catalog with modifications. I am inquisitive regarding the most vi motors that flip the wheels, therefore the rover will move forward or backwards, and therefore the four motors that flip the outer wheels around their axes, therefore the rover is mobile[10].

2.4.4 ZIGBEE:



Fig 10: ZigBee Module

ZigBee is a Wireless Personal Area Network (WPAN), an established set of digital wireless connections between computers and related devices. WPAN Low Rate or ZigBee offers specifications for devices with long battery life due to their low data rate and very low power consumption. ZigBee enables a fully networked home where all devices can communicate and control in a single unit[6].

WHEELS:

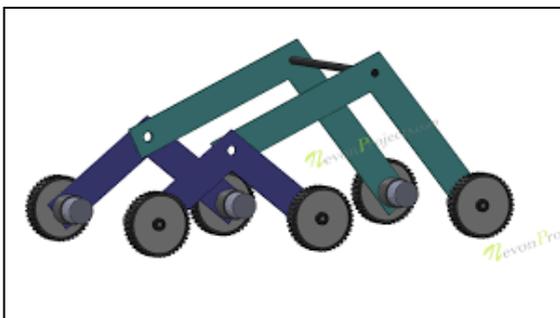


Fig 11: Wheels

All the mars rovers works based on rocker bogie mechanism. It consists of Six Wheeled Robot with Four Wheel Drive in which four wheels are connected with motor and remaining are idle wheels.

ARDUINO:

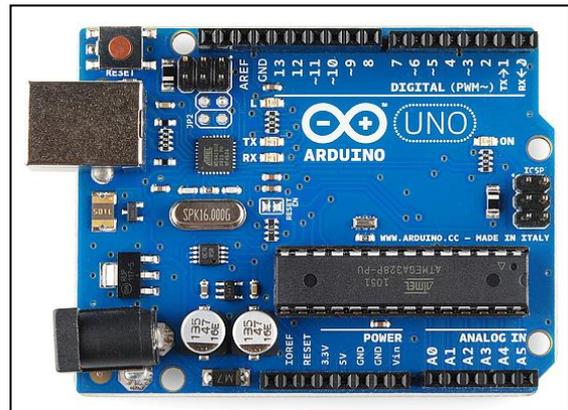


Fig 12: Arduino

Arduino/Genuino Uno is an ATmega328P based microcontroller board (datasheet). It has 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal, a USB connection, a power jack, an ICSP header, and a reset button . It contains everything you need to support a microcontroller. Connect it to your computer with a USB cable or power it up with an AC-DC adapter or battery to get started. You can play around with UNO without worrying too much about making mistakes. In the worst case, it can be replaced.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. Version 1.0 of the Uno board and Arduino software (IDE) is the reference version of Arduino, which is now evolving to newer versions. The Uno board is the first in a series of Arduino USB boards, and the reference model for the Arduino platform; For a complete list of current, past, or obsolete boards, see the Arduino Board Index[9].

3.CONCLUSION:

From the literature survey we have done above based on the mars rover. We have studied that what is a rover and its use for future applications. From the history we have understand that there various types of rovers have been sent to the mars in order to obtain useful information to know whether is there any possibility of life on mars planet. In the components we have studied about the individual

components of rover and its use. The rover uses rocker bogie mechanism in order to have smooth movement on surface on mars.

4. REFERENCES:

- [1].Max Bajracharya, Mark W. Maimone, Daniel Helmick, Autonomy for Mars rovers: past, present, and future, IEEE Computer Society, 2008, pp. 44–50.
- [2].K.C. Di, A review of spirit and opportunity rover localization methods, *Spacecraft Eng.* 18 (5) (2009) 1–5.
- [3]. Michel Maurette, Mars rover autonomous navigation, *Auton. Robots* 14 (2003) 199–208.
- [4].Arvidson, R. E., et al., Physical properties and localization investigations associated with the 2003 Mars Explorations rovers, *J. Geophys. Res.*, 108(E12),
- [5]. Maki, J. N., et al., Mars Exploration Rover Engineering Cameras, *J. Geophys. Res.*, 108(E12), 8071, doi:10.1029/2003JE002077, 2003.
- [6] ZigBee Alliance, ZigBee Specification. Version 1.0 ZigBee Document 053474r06, December 14th, 2004.
- [7].<https://mars.nasa.gov/mars2020/mission/overview/>
- [8].<https://mars.nasa.gov/mer/mission/overview/>
- [9]. ArduinoBoardUno.co.in
- [10]. www.maxongroup.co.uk
- [11]. www.Researchgate.net
- [12]. Mars.nasa.gov