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MARS EXPLORATION ROBOT WITH FEEDBACK UNIT

Mrs.K. ANOOSHA[1], U.SAI TEJA[2], B.MAHENDER[3] , D.VAMSHI[4]

1,Assistant Professor,Dept of Mechanical,Guru Nanak Institute of Technology, Hyderabad, Telangana.
2,3,4 Student, Department of Mechanical,Guru Nanak Institute of Technology, Hyderabad, Telangana

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Abstract - In the present world Robotics have become part of life, specially in industrial automation, defence, automobile and medical sectors. Due to the robotic technology the advances in technology and automation has improved. This improvement has largely helped industrial processes with ever-decreasing degrees of human operator participation.

Earlier robots cannot rover effectively all over the place due to their limitations in wheeling mechanism and fixed camera. In this project we have overcome the limitations and this project is useful for collecting data by visualizing where humans cannot enter certain places. We are using Night vision IP camera with pan and tilt mechanism, and we are using rocker bogie mechanism which is a 6 wheeled.

1.INTRODUCTION

The human body, with its limited form and senses, can only explore a small portion of the physical world. However, this limitation is a handicap to the infinite potential of the human intellect, which strives to discover the ends of the world. Technology has removed this limitation by allowing man to explore to the deepest seas and the farthest galaxies. Today most of the missions to deep-sea vents, distant galaxies and neighbouring planets are handles using multifunctional Rover bots. The Mars Rover is a vehicle that has been designed to traverse the rugged terrains of Mars and collect samples of various items on Mar's surface. Scientists over the years have tried to explore the possibility of life on Mars. Such explorations have been mostly done using rovers. Hence rovers need to be specially designed to traverse all kinds of terrains and must be equipped with state-of- the-art technology. A common design element is most rovers over the years is the rocker bogie mechanism. The rocker bogie mechanism has quite a lot of advantages and is hence a well-established mechanism. The main advantage is that it ensures that all the wheels of the rover are in contact with the ground always. This advantage is key to creating a stable all terrain system. Consequently, the traction of the rocker bogie provides is equal and reliable allowing a smooth running even on the uneven terrains.

1.2 EXISTING MODEL

Existing model not effective in all grounds (not having rocker bogie) used only for monitoring and it is fixed position and no other sensors is used.

1.3 PROPOSED MODEL

It has rocker bogie mechanism shows effective in all types of grounds and the robot is equipped with pan and tilt camera system, so can cover 360 degree of robot surrounds and it is night vision IP camera, this robot has moisture sensor to detect the water using Bluetooth module to operate the robot.

1.4 INTRODUCTION TO ROBOTICS

Robotics is a branch of engineering and science that includes electronics engineering, mechanical engineering, and computer science and so on. This branch deals with the design, construction, use to control robots, sensory feedback, and information processing. These are some technologies which will replace humans and human activities in coming years. These robots are designed to be used for any purpose, but these are using in sensitive environments like bomb detection, deactivation of various bombs etc. Robots can take any form but many of them have given the human appearance. The robots which have taken the form of human appearance may likely to have the walk like humans, speech, cognition and most importantly all the things a human can do. Most of the robots of today are inspired by nature and are known as bio-inspired robots.

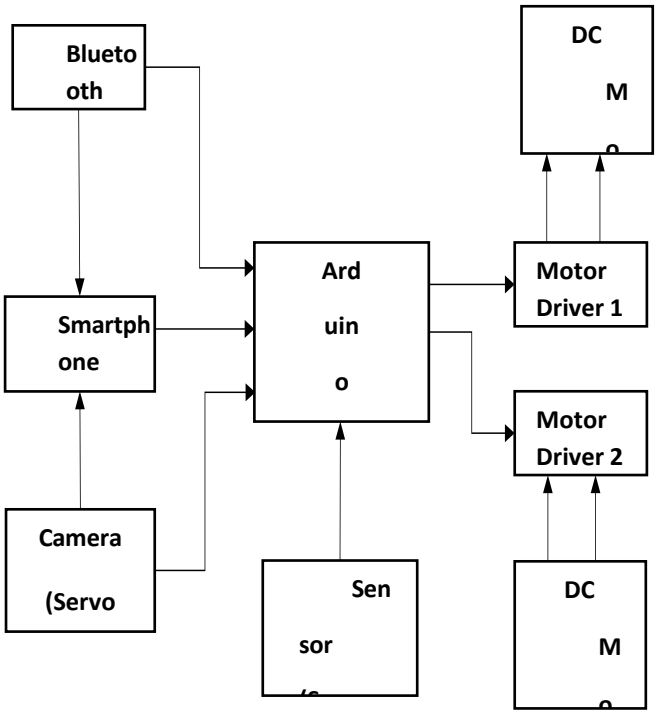
Robotics is that branch of engineering that deals with conception, design, operation, and manufacturing of robots. There was an author named Isaac Asimov, he said that he was the first person to give robotics name in a short story composed in 1940's. In that story, Isaac suggested three principles about how to guide these types of robotic machines. Later on, these three

principals were given the name of Isaac's three laws of Robotics.

CHAPTER 2

BLOCK DIAGRAM AND EXPLAINATION

BLOCK DIAGRAM



EXPLAINATION

This project is based on a micro-controller. Where we are using Arduino, Servo motors, Bluetooth, IP camera, Moisture Sensor to build this rover robot setup. A Bluetooth robot controller application is used to transmit commands over Bluetooth from a mobile phone. Based on the programming logic and the received characters the microcontroller operates the motors. Motors are controlled using the motor driver. Hence the robot moves forward, backward, right and left based on the commands given over Bluetooth. An IP camera is mounted over the robot which captures the video and transmits over the network Another mobile, or any streaming device connected to the same network can view the live stream transmitted from the IP camera.

MOTOR DRIVER

Motor Driver circuits are current amplifiers. They act as a bridge between the controller and the motor in a motor drive. Motor drivers are made from discrete components which are integrated inside an IC. The input to the motor driver IC or motor driver circuit is a lowcurrent signal.

MICRO CONTROLLER

A Microcontroller (or MCU) is a computer-on-a-chip used to control electronic devices. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrastto a general-purpose microprocessor. A typical microcontroller contains all the memory and interfaces needed for a simple application, whereas a general purpose microprocessor requires additional chips to provide these functions.

BLUETOOTH MODULE

This robot has a Bluetooth receiver unit which receives the commands and give it to the microcontroller circuit to control the motors. The microcontroller then transmits the signal to the motor driver IC's to operate the motors. This Robot is controlled by using Android mobile which has a transmitting device and Bluetooth module placed in Robot is used as receiver. Android phone will transmit command using its in-built Bluetooth to Robot so that it can move in the required direction like moving forward, reverse, turning left, turningright and stop.

POWER SUPPLY

The power supply section is the section which provide +5V for the components to work. ICLM7805 is used for providing a constant power of +5V. The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output.

SERVO MOTOR

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, oftena dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor, although the term servomotor is often used torefer to a motor suitable for use in a closed-loop control system.

BATTERY

A 12v lithium battery or an adaptor is used. Originally, "lithium polymer" stood for a developing technology using Fig:1.1-Manual disinfection instead of the more common liquid electrolyte. The result is a "plastic" cell, which theoretically could be thin, flexible,and manufactured in different shapes, without risk of electrolyte leakage. This technology has not

been fully developed and commercialized, and research is ongoing.

Classification by Degrees of Freedom

The degrees of freedom of a robot typically refer to the number of movable joints of a robot. A robot with three movable joints will have three axis and three degrees of freedom, a four-axis robot will have four movable joints and four axis, and so on. Based on the mechanism and the leg design the degrees of freedom changes. So, DOF depends on the independent motions.

1.5.2. Robotic Movements.

Fixed: Most of the fixed robots are industrial robots which work in well-defined environments. These robots are mounted on a stable base on the ground and based on their internal configuration, they can compute their positions.

Mobile: As the name suggests, mobile robots are not fixed to a surface, rather can achieve free movement over the surface. It can be a legged or a wheeled robot.

Legged: These are generally the walking robots which use limbs for movement. These are mostly used to provide movement in highly unstructured environments. Though complex to design, these robots have a greater edge over wheeled robots in terms of navigation on any kind of path or terrain.

1.6. Arduino IDE

The Arduino Integrated Development Environment – or Arduino Software (IDE) - contains a word processor for composing code, a message region, a message console, a toolbar with buttons for normal capacities and a progression of menus. It associates with the Arduino equipment to transfer programs and speak.

Mars exploration robot

The Mars Exploration Rover is a vehicle that has been designed to traverse the rugged terrains of Mars and collect samples of various items on Mar's surface. Scientists over the years have tried to explore the possibility of life on Mars. Such explorations have been mostly done using rovers. Hence rovers need to be specially designed to traverse all kinds of terrains and must be equipped with state of the art technology. A common design element is most rovers over the years is the rocker bogie mechanism. The rocker bogie mechanism has quite a lot of advantages and is hence a well-established mechanism. The main advantage is that it ensures that all the wheels of the rover are in contact with the ground at all times. This advantage is key to creating a stable all terrain system. Consequently the traction of the rocker bogie provides is equal and reliable allowing a smooth running even on the uneven terrains. As part of its Mars Exploration Rovers (MER)mission, NASA landed twin rovers, named Spirit and Opportunity, on Mars in January of 2004. These rovers are explicitly required to use robotic mobility and manipulator arm positioning functionality to achieve exploration objectives by serving as surrogate robotic field geologists for a science team on Earth. Software functionality that enables these robotic tasks includes wheel motion control and vision-guided autonomous navigation functions of varying complexity for traversing the Martian surface, as well as robotic arm motion control functions for accurate placement of scientific instruments onto rocks and soil. Mobility and robotic arm software runs onboard the rovers' computers to perform various exploration tasks. Tasks are specified in command loads unlinked to the rovers by engineers who plan their daily robotic activities on Earth.

CHAPTER 3

LITERATURE SURVEY

[1] Depositional and Diagenetic Processes of Martian Lacustrine Sediments as Revealed at Pahrump Hills by the Mars Hand Lens Imager, Gale Crater, Mars, The Murray formation represents fine-grained sedimentary deposition in lacustrine environments within Gale crater, Mars. Both the overall thickness of the Murray formation and its broad uniformity in sedimentary character suggest the potential for a long-lived, groundwater-supported lake system. Rock textures were imaged by the MAHLI camera at the Pahrump Hills location, which represents the lowermost Murray formation. We analyze data from Pahrump Hills to refine earlier estimates of grain size and grain size distribution, as well as to make detailed observations of diagenetic features and modification of primary sedimentological features. These observations and resulting interpretations provide a detailed look at the dynamic behavior of lake systems on Mars. The lower portions of this exposure are characterized by planar laminated, fine-grained material; the predominant grain size in this region is smaller than very fine sand. Diagenetic mineral precipitation is also prominent in these lower layers, evidenced by likely in-situ precipitation of lenticular crystals, preferential cementation of laminae in several layers, precipitation of

late-diagenetic crystal clusters, and secondary modification of previously-deposited crystals. The upper portions of this locality are coarser-grained, varicolored, and contain cross-stratified features. The variation of these features over a relatively thin stratigraphic interval indicates rapid fluctuation in the hydrodynamic behavior of Gale crater lake, similar to that observed in the shallow-water regions of terrestrial closed basin lakes

[2] The Martian surface radiation environment at solar minimum measured with MSL/RAD, The radiation environment at the surface of Mars is mainly dominated by incoming galactic cosmic rays (GCRs) that propagate through the atmosphere, with sporadic strong contributions from solar energetic particles (SEPs). The main driver for changes in the radiation field, on time scales of years, is the solar modulation of the GCR flux. During times of higher solar activity, GCRs are more strongly attenuated, resulting in highest GCR fluxes during solar minimum and lowest fluxes at solar maximum. We report dosimetric measurements conducted with the Radiation Assessment Detector (RAD) from November 2019 to October 2020 during the recent deep solar minimum. RAD has been operating on board NASA's Curiosity rover on Mars since August 2012. We bring these measurements into context with RAD measurements from 2012 to 2013 around the (weak) maximum of Solar Cycle 24. The results show the impact of the changing solar modulation from 2012 to 2020 on the Martian surface radiation environment and have implications for future human exploration missions of Mars. We find that while the overall radiation dose rate has increased significantly by 50% between the two time frames, the biologically highly relevant dose equivalent rate shows a modest increase of 13%, yielding interesting input for the timing of such Mars missions within the solar cycle. We also report the first results of the analysis of the flux of medium-energy protons with 100–300 MeV on the Martian surface, yielding an important additional, in-situ measured data point for validating radiation transport models.

[3] Elemental composition of manganese- and phosophorus-rich nodules in the Knockfarril Hill member, Gale crater, Mars, The Mars Science Laboratory rover Curiosity encountered nodules rich in manganese and phosphorus while exploring the Knockfarril Hill member of Gale crater on Mars. Deconvolution of X-ray spectroscopy data acquired by the Alpha Particle X-ray Spectrometer (APXS) at the spectral level indicate P2O5 concentrations possibly in excess of 18 wt% and MnO exceeding 8 wt%. The nodules occur intermittently in ~mm-thick layers concordant with the sedimentary laminae, extending up to ~10 cm laterally. Calcium sulfate associated with the nodules is interpreted as having precipitated from fluid that infiltrated between the nodule-bearing bedding planes in a separate and subsequent fluid event. Though the Mn- and P-bearing phase(s) was(were) not definitively identified by X-ray diffraction, evolved gas analyses show that the oxidation state of Mn is most likely.

[4] Diurnal variability in aeolian sediment transport at Gale crater, Mars, A suite of high resolution cameras onboard the Mars Science Laboratory (MSL) Curiosity rover have provided an unparalleled look at active aeolian processes on Mars, including within the first active dune field explored on another planet, the Bagnold Dunes. Here we present results from a subset of MSL's repeat imaging (“change detection”) experiments with temporal resolutions sufficient to probe the diurnal variability in winds within Gale crater. Images reveal that saltation is a near-daily phenomenon during southern summer, with repeatable diurnal circulation patterns producing steady impact ripple migration toward the west/southwest. Nighttime fluxes are inferred to be ~four times larger than daytime fluxes, consistent with predictions from the MarsWRF model of multiple periods of enhanced wind between sunset and sunrise. Multiple factors are likely facilitating saltation at this time: (a) time-averaged nighttime winds have a higher degree of variance (i.e., higher peak friction speeds) than daytime winds, (b) interactions between regional Hadley flows and local, thermally driven slope winds cause increased turbulence at night, and (c) relatively higher atmospheric density produces correspondingly higher shear stresses and decreases critical thresholds. Observations of sand transport at a range of spatiotemporal scales (down to scale of individual particles moving on the timescale of seconds) support the idea that bedform migration is driven by intermittent, low-flux saltation events when winds fluctuate between canonical impact and fluid thresholds. Yet, whereas gustiness may play a role in initiating transport, saltation is found to be highly predictable on diurnal timescales and is only stochastic on the shortest timescales characteristic of turbulent fluctuations in wind.

[5] Planetary Waves Traveling Between Mars Science Laboratory and Mars 2020, Using Perseverance (Mars 2020) and Mars Science Laboratory (MSL) measurements, we obtain planetary waves with a

period of 1.5–30 sols in the 1.5 m temperature, winds (Mars 2020), surface pressure, and relative humidity. Planetary waves emerge and propagate latitudinally across all variables. Short-period waves peak at periods of ~2, 3, and 4.5 sols, confirming previous detections of waves, and wave amplitudes agree at Mars 2020 and MSL for all variables. The simultaneous detection of waves within Gale and Jezero craters in multiple variables indicates that planetary-scale dynamics influences many facets of local weather throughout the year. Multiple waves are correlated or anti-correlated between MSL and Mars 2020, suggesting waves originate in both hemispheres. Further, waves at one site do not always lead the other, suggesting a combination of baroclinic and barotropic processes as wave sources, determined from the phasing of the temperature and winds in Jezero compared to the Ensemble Mars Atmospheric Reanalysis System.

[6] Manganese Mobility in Gale Crater, Mars: Leached Bedrock and Localized Enrichments, In Gale crater on Mars, the rover Curiosity has discovered evidence of fluid mobilization of the redox-sensitive element manganese. We present results for Mn from Curiosity's Alpha Particle X-ray Spectrometer (APXS), which show that the average MnO concentration in mudstone-dominated sedimentary units (0.22 wt%) is about one-half of the concentration in the average Mars crust (0.44 wt%). Geochemical trends indicate that Mn in the sedimentary bedrock, most of which has a basaltic provenance, was leached by chemical alteration and dissolution. In >350 vertical meters of mudstone-dominated strata, the apparent leaching of Mn and retention of Fe in Fe-O-H phase(s) resulted in the fractionation of Fe and Mn, indicating relatively moderate Eh-pH fluid conditions that were not highly alkaline, reducing, or oxidizing. Exceptions are fracture-associated, silica-rich haloes where both Mn and Fe were leached by low pH fluids. The rover also discovered Mn-rich veins, nodules, and patchy, dark coatings on rock surfaces, which are variably associated with enrichments in Fe, P, Cl, and/or Zn. These Mn-rich features represent ~1% of the 1029 APXS measurements acquired over ~25 km of rover traverse. A thermochemical model shows that dissolved Mn2+ could have been concentrated via evaporation, sublimation, and/or freezing. Manganese was then likely precipitated in localized features when >99.99% of the Mn2+-bearing water was removed from the system. These findings indicate that Mn was mobile in Gale crater and therefore bioavailable as a potential energy source for life.

[7] Barform deposits of the Carolyn Shoemaker formation, Gale crater, Mars, The early environmental history of Mars is encoded in the planet's record of sedimentary rocks. Since 2012, the Curiosity rover has been ascending Mount Sharp, Gale crater's central mound, making detailed observations of sedimentary strata exposed there. The primary depositional setting represented by the rocks examined thus far has been a perennial lake, represented by the mudstones and sandstone lenses of the Murray formation. Here, we report on the sedimentology of outcrops examined in the Carolyn Shoemaker formation, which sits stratigraphically above the Murray formation. We interpret strata exposed in the Glasgow and Mercou members of the Carolyn Shoemaker formation to represent river bars in ancient alluvial and shoreline settings based on sedimentary structures, stratal geometries measured from photogrammetric data, and erosional morphology. The transition from a lacustrine to a fluvial depositional setting records the aggradation and progradation of coastal rivers into what was previously the extent of the Gale lake system. This may have occurred due to the shrinking of the lake over time due to climate-driven changes in the basin water balance, or local three-dimensionality in shoreline evolution, such as the formation of a new sedimentary lobe following a channel switch.

[8] Martian landscapes of fluvial ridges carved from ancient sedimentary basin fill, Large sedimentary basins contain archives of Earth history. It is unknown to what extent similar basins existed on Mars because there are few observations relating to the subsurface and it is difficult to identify buried deposits. Here, we used numerical simulations to show that landscapes of networks of topographic ridges that are abundant on the surface of Mars may represent erosional windows into thick, basin-filling river deposits that accumulated over long time spans. We used a numerical model to drive hillslope creep and differential erosion from the wind to simulate Mars-like exhumation processes acting on basin-filling fluvial strata, which we based on those buried in the Gulf of Mexico on Earth, as imaged using three-dimensional reflectance seismology. Simulations produced remarkably Martian landscapes in which the preferential erosion of mudstone relative to sandstone channel belts leads to the development of complex patterns of intersecting ridges. Our findings contrast to the existing view of ridged Martian landscapes as thin-

skinned surface deposits preserving fluvial landscapes at a snapshot in time. Instead, the ridge cross-cutting patterns produced by the model reflect the exhumation of channel bodies at different stratigraphic levels, exposing basin strata accumulated over time scales of 500,000 years. Thus, we propose that fluvial ridges on Mars may expose an archive of long-lived aqueous processes.

[9] Water uptake by chlorate salts under Mars-relevant conditions, Chlorine is ubiquitous on Mars, some of it in the form of oxy-chlorine salts. Chlorine-containing salts have been found at several landing sites, including that of Phoenix and Curiosity, in the form of perchlorates and chlorides. Several intermediate states also exist, of which chlorate is the most stable. While perchlorates have received much attention in the past few years, chlorate salts are much less studied. The ratio of perchlorate to chlorate on Mars is not well-defined but may be approximately 1:1. Chlorate salts have similar properties to perchlorates: high solubility, low eutectic temperatures, and likely low deliquescence relative humidities. Laboratory studies were performed to determine the ability of sodium and magnesium chlorate salts to take up water vapor at low temperatures (296 K to 237 K). These studies were performed using a Raman microscope equipped with an environmental chamber and a single particle optical levitator equipped with a Raman spectrometer. The deliquescence of sodium chlorate (NaClO3) was found to be temperature-dependent with the average relative humidity (RH) values ranging from 68% RH at 296 K to 80% RH at 237 K. Additionally, there was a slight deviation between experimental deliquescence values for this salt and those predicted by equilibrium thermodynamics. The observed efflorescence (recrystallization) of NaClO3 occurred at lower RH values ranging from 18% RH at 264 K to 24% RH at 249 K, demonstrating the hysteresis common to salt recrystallization. Several experiments were performed below the reported eutectic temperature of NaClO3 which resulted in supercooling of the brine and depositional ice nucleation. Based on the supercooling effects observed during our experiments, a revised metastable eutectic temperature of 237 K is suggested for NaClO3 compared to the previously reported value of 252 K. Two phases of magnesium chlorate (Mg(ClO3)2) were observed and exhibited different water uptake behavior. The most common form of Mg(ClO3)2 appeared to be a hydrated, amorphous phase, Mg(ClO3)2 • X H2O(a) that continuously took up water when the RH was increased. This water uptake behavior was even observed at very low humidity values, 5.0 (±1.9)% RH, with little temperature dependence. This detectable water persisted down to RH values close to 0%, averaging 0.5 (±0.6)% RH with no visible temperature dependence. The deliquescence relative humidity (DRH) of the hexahydrate, Mg(ClO3)2 • 6 H2O, was found to range from 50.9 (± 7.5)% at 227 K to 55.8 (± 6.6)% at 224 K and was consistent with thermodynamic calculations. Under conditions measured by the Remote Environmental Monitoring Station (REMS) instrument at Gale Crater and conditions modeled in the shallow subsurface, magnesium chlorate, if present, likely interacts with water vapor during some diurnal cycles.

[10] On an Extensive Late Hydrologic Event in Gale Crater as Indicated by Water-Rich Fracture Halos, We analyze spatially pervasive, light-toned “halos” associated with fractures in a sedimentary unit (Stimson) of Gale crater, Mars, and report a similar network of halos discovered in a separate geologic group (Bradbury). Through a dedicated active neutron measurement campaign, we provide independent confirmation of the water-rich nature of these features. Together with mineralogical and geochemical data, these features are consistent with abundant hydrated amorphous silica (opal-A). We suggest that the mineral and amorphous assemblages are indicative of formation under low-temperature and predominantly low-pH conditions (passive silica enrichment) with minor contribution of silica (active silica enrichment) from adjacent units. We show that there is significant amorphous silica in the array of sedimentary rocks in Gale crater, allowing them to play a role in an active silica enrichment phase of halo formation. We suggest that the involved alteration event was short lived and our finding of vast halo networks in a distant, older unit implies a more vast network of hydrologic subsurface conduits than previously known. This relatively recent subsurface hydrologic system was present long after the transition from a warm and wet to a cold and dry Martian environment, extending the habitability conditions on Mars to an epoch that is generally considered not favorable for life on the surface. Finally, our bulk H quantification of these features, which ranges from ~3–6 wt% H2O-equivalent-H, suggests that the amorphous material in halos hosts ample supplies of readily released water, making them a considerable resource at the otherwise dry Martian equator.

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