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Mars exploration robot with feedback unit

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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. Arduino UNO processor is used for faster processing with its user interface, GUI in Arduino IDE, and IP camera for collecting and monitoring surroundings in this project. This robot can accurately monitor even in dark surrounding and live telecast, and such robot can be operated on uneven grounds.

KEYWORD: — *Planet Exploration; Mars Rover; Embedded Systems; Wireless Sensors; Robotics*

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I. 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-ofthe-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. Move over obstacles whose sizes are significantly larger than the wheel diameter because it makes use of an extra set of wheels to provide greater forward thrust. The extra set of wheels also divides the traction force required from each wheel to 1/6th the total value. Moreover, reduced forward thrust is required because the front wheels only need to lift 1/3 of the total weight of the rover. Acting together, the rear four wheels provide enough traction to keep the rover from slipping.

1.1 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.

1.2 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.

II. LITERATURE SURVEY

1.From past few years initiatives for planet exploration is increasing. NASA and Mars Society is involving students, academia's to bring out different solutions to explore mars for example University Rover Challenge [1]. At university rover challenge students from all over the world build and perform different tasks based on mars

exploration missions at an artificially made surface which is same as mars surface. There are several initiatives are taken to engage students in planetary exploration UK University Rover Challenge, European Rover Challenge, University Rover Challenge. First world countries are way ahead in building, developing mars rover. Third world countries are also inspired and taking initiative's but not many [2]. Mars rover which is proposed here is capable of complete the missions assigned by mars society for university rover challenge and after future up gradation is possible to use it for planet mars. Another issue for developing countries is cost. In this proposed mars rover all the criteria's and functionality is implemented at a minimal cost. Efficiency of the system is capable of giving a proper result from collected data to find life on mars, difference of surface soil from eart possibilities of water on mars, navigation and exploration

2. 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, groundwatersupported 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.

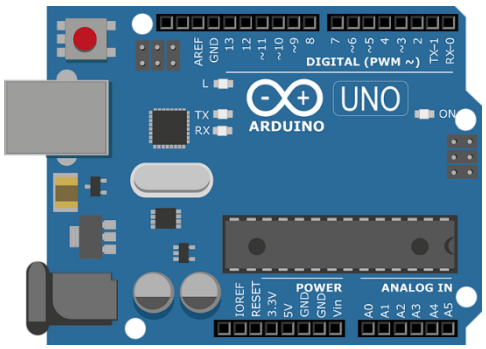
3.Elemental composition of manganese- and phosophorus-rich nodules in the Knockfarril Hill member, Gale crater, Mars, The Mars Science Laboratory rover Curiosity encountered nodules rich in manganese and phosphorus while exploring the Knockfarril Hill member of Gale crater on Mars. Deconvolution of X-ray 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

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:

WORKING PRINCIPLE

Firstly, the supply voltage of 12V through battery is given to the Distribution Board, through which step-down supply is given to Arduino UNO (Microcontroller) and Motor driver. The Motor driver is connected to Motor-1, Motor-2 (Robot wheels) and Motor-3 (for Brush rotating mechanism). The Arduino UNO is interfaced with Bluetooth module through an app called Roboman App. This app is used for controlling the robot movements i.e. left, right, backward, forward. Wireless IP Camera is connected to Arduino UNO and it is used for inspection and we can observe live stream of the railway track from obstacles. This IP camera is interfaced using an application called HD WiFi CamPro App. The brush rotating mechanism is switched ON as soon as the power supply is given to the robot. Using this mechanism the trash is collected along the track into the area of trash collection in the robot. It is accomplished by giving manual control commands to the robot through Roboman App. Hence, the Railway track inspection and trash collection is accomplished by the Robot.

ARDUINO UNO



Arduino UNO ATmega328p

Arduino uno is a micro-controller. It is based on a Microchip ATmega328P. Itis developed by Arduino.cc. The chipset has set of digital and analog I/O pins, whiused to interface with various other boards and circuits. The board has 14 digital and 6 analogI/O pins. Arduino IDE is used to program this module. The microchip comes pre-programmed with a bootloader, so we don't need any external hardware programmer to upload the code. Here we use this module to handle all the processes of the robot. It worksas a brain for whole system. By using app and Bluetooth module interface we can managethe actions performed by robot. The Arduino UNO includes 6 Analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed basedon IDE, which stands for Integrated Development Environment. It can run on both onlineand offline platforms. The IDE is common to all available boards of Arduino.

Memory

The ATmega328 has 32 KB (with 0.5 KB occupied by the boot loader). It also has 2 KBof SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode(), digital Write, and digital Read functions. They operate at 5 volts. Each pin can provideor receive 20 mA as recommended operating condition and has an internal pull-up resistor(disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must notbe exceeded on any I/O pin to avoid permanent damage to the microcontroller.

The Uno has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e., 1024 different values). By default, they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference () function. There are a couple of other pins on the board:

HC-05 BLUETOOTH MODULE

HC-05 Bluetooth Module

HC-05 module is an easy-to-use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip

Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

POWER SUPPLY

A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated asLiPo, LIP, Li-poly, lithium-poly and others), is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. High conductivitysemisolid (gel) polymers form this electrolyte. These batteries provide higher specific energy than other lithium battery types and are used in applications where weight is a critical feature, such as mobile devices, radio-controlled aircraft and some electricvehicles.

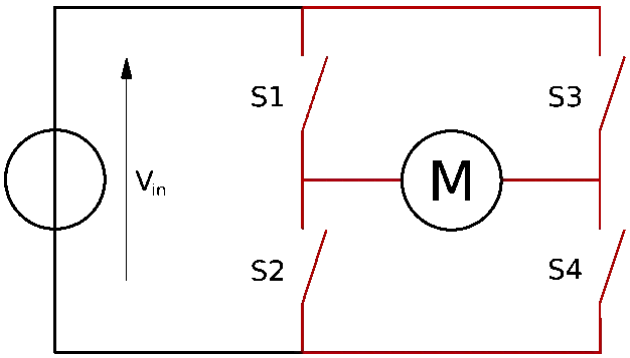
Lithium Polymer Battery

Lithium polymer cells have evolved from lithium-ion and lithium-metal batteries. The primary difference is that instead of using a liquid lithium-salt electrolyte (such as LiPF6)held in an organic solvent (such as EC/DMC/DEC), the battery uses a solid polymer electrolyte (SPE) such as poly(ethylene oxide) (PEO), poly(acrylonitrile) (PAN), poly(methyl methacrylate) (PMMA) or poly(vinylidene fluoride) (PVdF).

L298 - MOTOR DRIVER

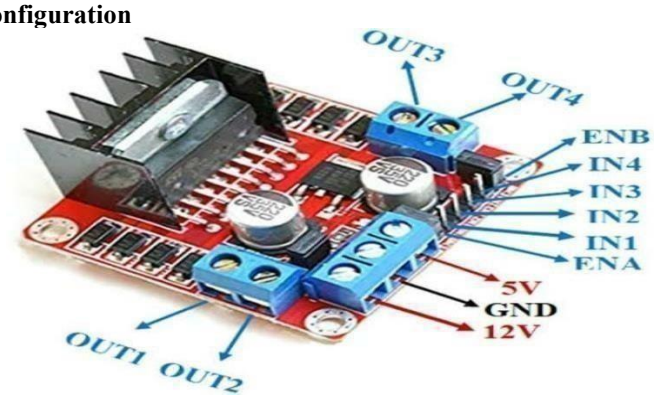
giving appropriate logic to the motor driver module. A motor driver module is a simple circuit used for controlling a DC motor. It is commonlyused in autonomous robots and RC cars (L2938N and L293D are the most regularly utilized motor driver chips). A motor driver module takes the low voltage input from a controller like Arduino. This input logic controls the direction of DC motors connected to the driver. To put it in simple words, you can control the direction of DC motors . This **L298N Motor Driver Module** is a Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. **L298N Module** can control up to 4 DC motors, or 2 DC motors with directionaland speed control.

The L298N motor driver is based on the H-bridge configuration (an H-bridge is a simplecircuit that lets us control a DC motor to go backward or forward.), which is useful in controlling the direction of rotation of a DC motor.



H-bridge circuit diagram

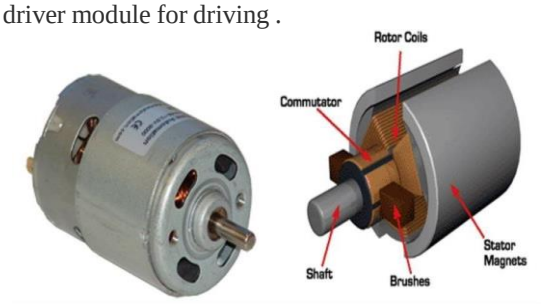
L298 Module Pinout Configuration



L298 Module Pinout Configuration

DC MOTOR

A direct current (DC) motor is a type of electric machine that converts electrical energy into mechanical energy. DC motors take electrical power through direct current, and convert this energy into mechanical rotation. DC motors use magnetic fields that occur from the electrical currents generated, which powers the movement of a rotor fixed withinthe output shaft. The output torque and speed depends upon both the electrical input andthe design of the motorhigh-power motor driver module for driving .



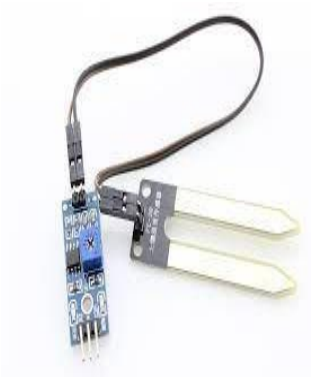
DC MOTOR

MOISTURE SENSOR

Moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, orinteraction with neutrons, as a proxy for the moisture content.

The relation between the measured property and soil moisture must be calibrated and mayvary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be usedby farmers or gardeners.

Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential; these sensors are usually referred to as soil water potential sensors and includetensiometers and gypsum blocks.

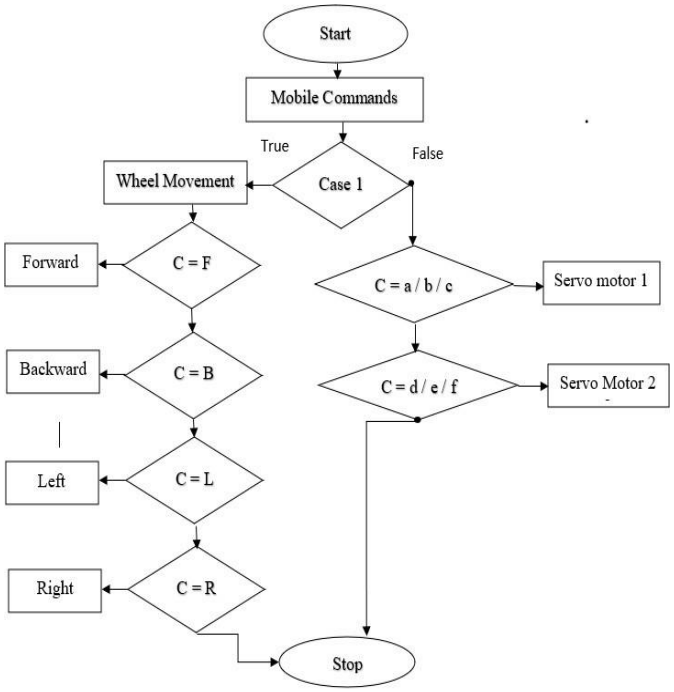


Moisture Sensor

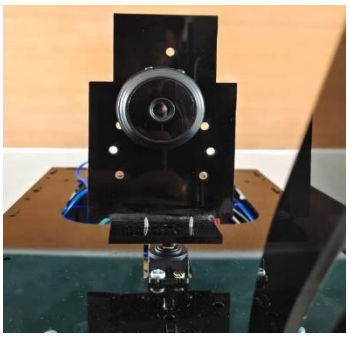
SERVO MOTOR

A servomotor is a rotary actuator or linear actuator that allows for precise controlof angular or linear position, velocity and acceleration. It consists of a suitable motor coupledto 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.

FLOW CHART

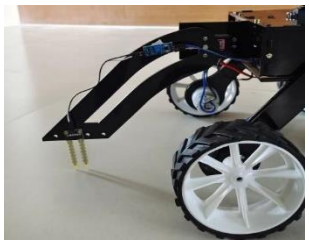


III. RESULT



Camera of Mini Mars Rover Robot

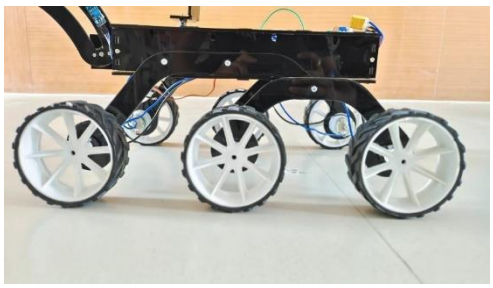
In above figure we can see that the camera is fixed on top of robot, it is used for spying and controlling the robot through smartphone app also, the video will be live streamed inthe HDWiFiCamPro mobile application. And the camera is attached to the pan and tilt mechanism.



Moisture sensor Up position; Moisture sensor Downposition

In the figure we can see that the moisture sensor is attached to robots with the help of movable rack which is connected to the robot with a servo motor. So that sensor can be moved up and down for sensing

IV. CONCLUSIONS



Mini Mars Rover Robot

This kind of robot is used for exploration, reusing, military, and spying also. By using such robots, we can explore any kinds of grounds and also the places where human cannotenter or not suitable to move in such areas. In this project we developed a smart robot formilitary applications which provide us surveillance on border areas. And we also use as spying robot in our required areas. We also sense the water presence with this robot. Wecan know the real time condition there and act further according to that. The personal rover combines mechanical expressiveness with a simple-to-use interface designed explicitly for a long-term human-robot relationship. Currently, three prototype rovers have been fabricated to prepare for preliminary user testing. Both from a mechanical anduser interface point of view, the rover is not yet sufficiently advanced to accompany a subject home for the month.

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