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Rover with Climbing Abilities Using Arduino Uno

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ABSTRACT- Rovers have become a key technology for unmanned mining and geographical explorations. To cope with the rough terrain encountered on most of the surfaces, new locomotion concepts for rovers and micro-rovers must be developed. In our paper we present a rover concept with six motorized wheels. Using a triangular configuration, the rover has a steering wheel in the front and the rear, and two wheels arranged on a bogie on each side. The front wheel has a spring suspension to guarantee optimal ground contact of all wheels at any time. The steering of the rover is realized by synchronizing the steering of the front and rear wheel and the speed difference of the bogie wheels. The use of parallel articulations for the front wheel and the bogies enables to set a virtual centre of rotation at the level of the wheel axis. This ensures maximum stability and climbing abilities even for very low friction coefficients between the wheel and the ground.

KEYWORDS: Rover, triangular configuration

I.INTRODUCTION

Rover is a vehicle designed for exploring different kinds of surfaces. It uses both hardware and software technology. Exploration rovers need to show strong off-road capabilities due to the unstructured environment met during their mission. Considering the growth, the nature of the exploration missions will change from pure exploration to real exploitation. This will drastically modify the nature of the operational environment which will be both structured and unstructured, especially in the case of construction robotics. Wheeled rovers are the optimal solutions for well structured environment like roads or habitations. But off-the road, their efficiency is very dependent to the typical size of obstacles they can encounter.

Usually, the size of the rover is determined by the size of encountered obstacles that must be overcome in a standard motion mode. The locomotion of a rover is of two types i) Active & ii) Passive. Active locomotion extends the mobility of a robot but increases the complexity and needs extended control resources. With the actual speed of the controllers, it is yet imaginable to perform active locomotion, and this is one of our research axes.

However, in the case of space autonomous robotics, predominant criteria are certainly the power consumption, the reliability, and the mobility of the system. High complexity of active robots and the poor climbing abilities of passive systems motivated us to develop and investigate new locomotion concepts for

passive and wheeled rovers. These considerations formed the basis for our project whose goal is to conceive and build a mobile robot based on the following requirements: a) The locomotion system had to be a wheeled rover showing good off-road abilities: maximum gripping capacity and stability during motion even in rough terrain. b) It had to passively overcome a step of 1 time its wheel diameter.

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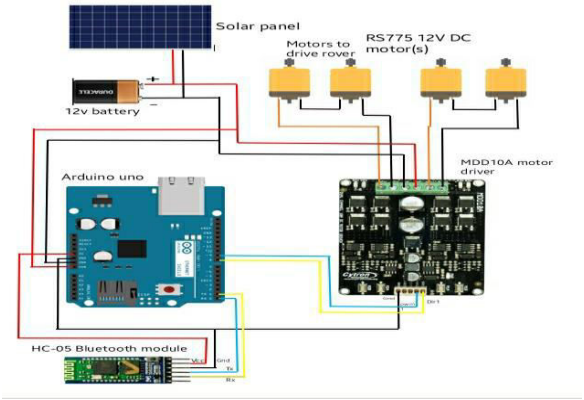
II.CIRCUIT DIAGRAM



The circuit consists of Arduino uno board, MDD10A motor driver, RS775 DC motor, 12V battery, HC-05 Bluetooth module and solar panel. The driver pin 'DIR1' and pulse modulation pin 'PWM1' of MDD10A are connected to pin 8 and pin 9 of Arduino board, respectively.

In motor driver circuit there are two channels to connect motors which provides 10A continuous current and 30A peak current,2 series connected RS775 12V DC motors are connected to both the channels. DC motor has rating of 0.6A of no-load current and 2A of on load current. The power pins B+ and B- are connected to 12V Battery.

Bluetooth module HC-05 Vcc and Gnd pins are connected to 5V and Gnd pins of arduino respectively. Transmission Tx and receiver Rx pins of Bluetooth module is connected to Rx and Tx pins of Arduino. Arduino circuit board is powered by 12V battery i.e., by connecting Vcc and Gnd of Arduino to battery.

III.OBJECTIVES

- To design a Rhombus frame that improves stability and improved steering and climbing capabilities.
- To design a Triangular wheel that improves the overall stress and load carrying capabilities without suffering any stress deformation.
- To design a Modular structure that allows for easy access and additional mounts and gadgets to be used on the rover.
- Too achieve a Rover that combines mechanical expressiveness with simple-to-use interface designed with explicitly for a long –term human-robot relationship.

IV. SYSTEM COMPONENTS

A. RS-775 DC motor

i.

Direct Current Motor is a device that converts the DC electrical energy to mechanic energy. DC Motor has a lot of applications in the control system, robotics, and industrial.

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. The output torque and speed depend upon both the electrical input and the design of the motor.

Fig 1. RS-775 DC Motor

Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a

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lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator, and hoists, and in drives for steel rolling mills.

B. MDD10A Driver

MDD10A is the dual channel version of MD10C which is designed to drive 2 brushed DC motors with high current up to 10A continuously. It is also using full solid-state components which result in faster response time and eliminate the wear and tear of the mechanical relay.

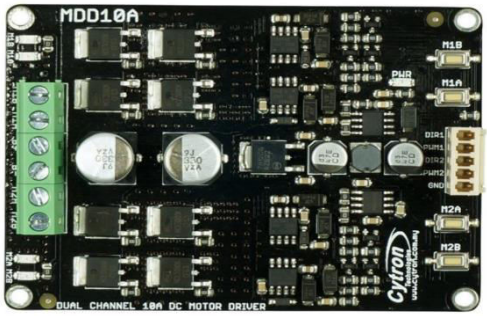

Fig 2. MDD10A Driver

It has a following features:

- Bi-directional control of 2 brushed DC motor.
- Support motor voltage ranges from 5V to 25V Maximum current up to 10A continuous and 30A peak (10 seconds) for each channel.
- Solid-state components provide faster response time and eliminate the wear and tear of the mechanical relay.
  Fully NMOS H-Bridge for better efficiency and no heat sink is required. Speed control PWM frequency up to 20KHz.

C. ARDUINO Uno

Arduino is an open-source microcontroller which can be easily programmed, erased, and reprogrammed at any instant of time. Introduced in 2005 the Arduino platform was designed to provide an inexpensive and easy way for hobbyists, students, and professionals to create devices that interact with their environment using sensors and actuators

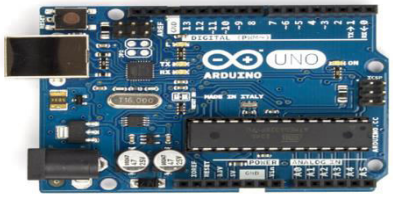

Fig 3.ARDUINO Uno

Based on simple microcontroller boards, it is an open-source computing platform that is used for constructing and programming electronic devices. It is also capable of acting as a minicomputer just like other microcontrollers by taking inputs and controlling the outputs for a variety of electronics devices. It is also capable of receiving and sending information over the internet with the help of various Arduino shields, which are discussed in this paper.

D. 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. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This 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).

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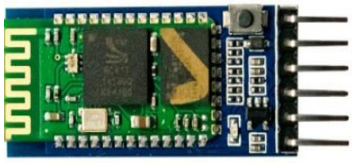

Fig 4. HC-05 Bluetooth module

E. Gears

A friction wheel with the teeth cut on its periphery is known as toothed wheel or gear.It is a positive drive. A gear drive is also provided, when the distance between the driver and the follower is very small.

Fig 5. Gears

F. Wheels

Wheels along with tires must take the entire weight of the vehicle, provide a cushioning effect and cope with steering control. Possible to remove or to stand the vehicle easily. To provide superior grip and to balance the load statically and dynamically.

Fig 6. Wheels

V. PROPOSED SYSTEM

The rocker-bogie design consisting of springs and stub axles in each wheel which allows the chassis to climb over any obstacles, such as rocks, ditches, sand, etc. that are up to one time the wheel's diameter in size while keeping all wheels on the ground maximum time. As compared to any suspension system, the tilt stability is limited by the height of the Centre of gravity and the proposed system has the same. Systems employing springs tend to tip more easily as the loaded side yields during obstacle course. The rover has one wheel mounted on a fork in the front, one wheel in the rear and two bogies with Triangular wheel configuration on each side. Although our bogies with Triangular wheel configuration have a special geometry, it is the same basic principle as used for a train suspension.

The parallel architecture of the bogies and the spring suspended fork provides a non-hyperstatic configuration for the 4 motorized wheels while maintaining a high ground clearance. This insures maximum stability and adaptability as well as excellent climbing abilities.

The climbing ability is mostly given by the sequential rising of the centre of gravity (CoG) provided by the consecutive

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action of the wheels. The centre of gravity goes up to 10% of the final height when the front wheel is on the top of the step. Then the first bogie wheel, helped by the action of the front fork, brings the CoG to 50%. The second bogie wheel and the rear wheel contribute each for approximately 25%. The mechanical structure allows a smooth movement of the CoG.

The climbing ability is mostly given by the sequential rising of the centre of gravity (CoG) provided by the consecutive action of the wheels. The center of gravity goes up to 10% of the final height when the front wheel is on the top of the step. Then the first bogie wheel, helped by the action of the front fork, brings the CoG to 50%. The second bogie wheel and the rear wheel contribute each for approximately 25%. It can be seen that the mechanical structure allows a smooth movement of the CoG.

VI.CONCLUSION

In this Project, we proposed an innovative wheeled rover which provides excellent climbing and steering capabilities. Based on a parallel architecture allowing high ground clearance and in the same time very good stability, this rover is able to passively overcome steps of one time of its wheel diameter, to climb stairs or to move in very rough terrain.

These capabilities are mainly provided by the parallel architecture of the suspension in combination with non-hyperstatic contact for all its wheels with the ground. The Tri-wheel rhombus configuration also gives a high escaping capability in unknown environments. Terrestrial applications are also numerous: indoor and outdoor surveillance, ventilating shaft cleaning, mining and construction machines, agriculture, or even mine clearance with good sensors.

REFERENCES

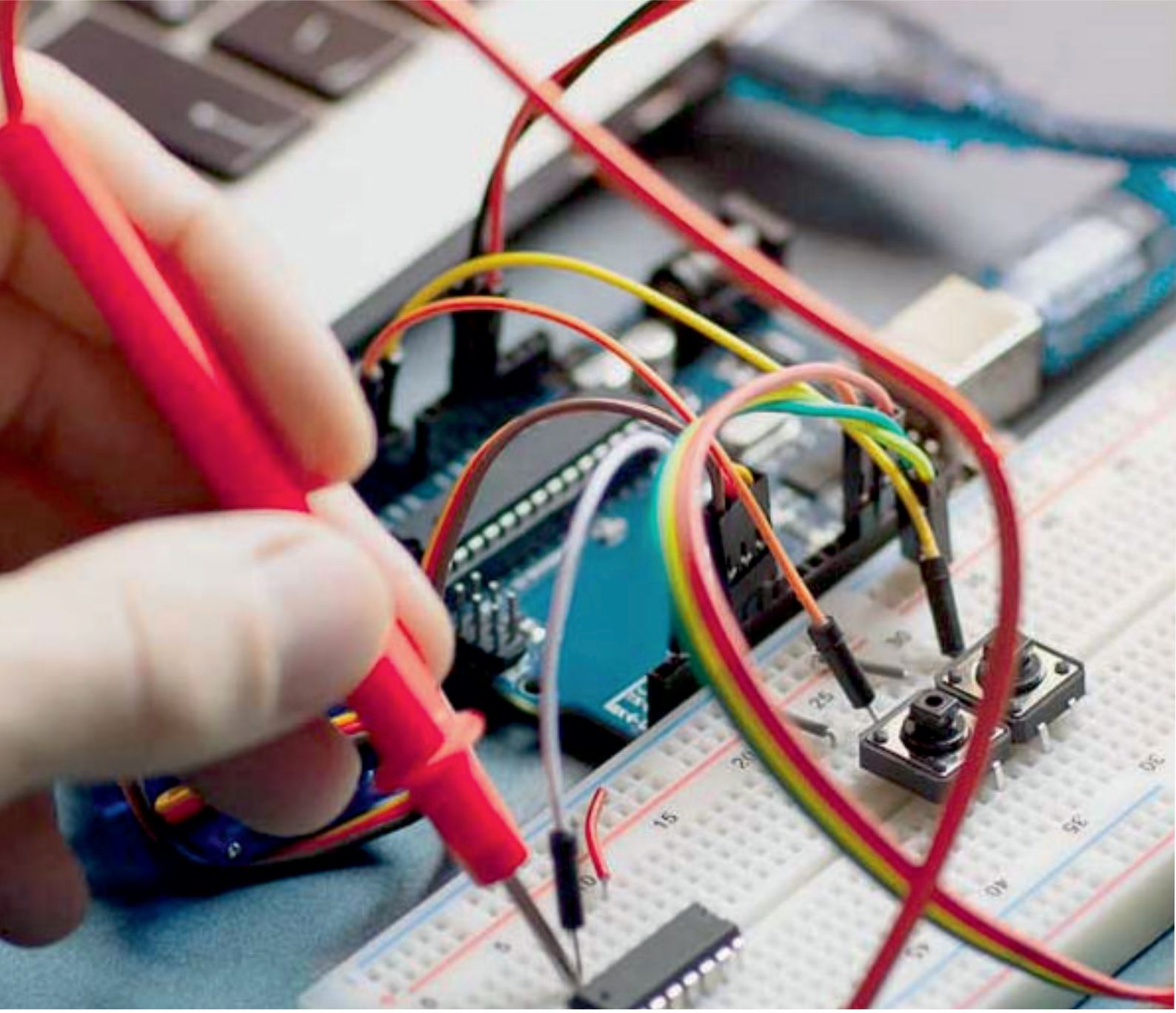
[1] T. Estier1, Y. Crausaz1, B. Merminod1, M. Lauria1, R. Piguet1, R. Siegwart1 “AN INNOVATIVE SPACE ROVER WITH EXTENDED CLIMBING ABILITIES”, - 2014.

[2 T. Estier1, Y. Crausaz1, B. Merminod1, M. Lauria1, R. Piguet1, R. Siegwart1, “AN INNOVATIVE SPACE ROVER WITH EXTENDED CLIMBING ABILITIES” - 2014

[3] Oladayo Olufemi Olakanmi, Mbadiwe Samuel Benyeogor, “INTERNET BASED TELE-AUTONOMOUS VEHICLE SYSTEM WITH BEYOND LINE-OF-SIGHT CAPABILITY FOR REMOTE SENSING AND MONITORING” -2018.

[4] “Iswanto, Alfian Ma‟arif, RikyDwi Puriyanto, Nia Maharani Raharja, SafintaNurindra Rahmadhia, ARDUINO EMBEDDED CONTROL SYSTEM OF DC MOTOR USING PROPORTIONAL INTEGRAL DERIVATIVE -2018

[5] Md. Razaul Haque Usmani ,Lafiz Maruf Rahman, Salsabil Ahmed, Imran Chowdhury, Jia Uddin, “HAZARD RECONNAISSANCE ROVER USING RASPBERRY PI AND MULTIPLE SENSORS”:-2019



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