

**VECTOR
(VERTICALLY ENHANCED CORROSIVE TESTING OPTIMAL ROVER)**

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ABSTRACT**

VECTOR means Vertically Enhanced Corrosive Resting Optimal Rover moveS vertically and horizontally,check the crack and corrosion in vertical surface and horizontal surface of the boilers and containers. The project was simple in design .It is mostly concentrated on the weight of the rover.Rover body are made by metal plates. The data are transferred byArduino.Movement of the rover is done by simple wheel transmission and brushless dc motor which produce power to the motor. It is used lithium battery, supply to charge the motor,NANO Board ,vacuum propeller and the working time is reduced , employees cost and increase the inspection accuracy with High Efficiency

INTRODUCTION

The project "VECTOR" fullform of vector is VERTICALLY ENHANCED CORROSIVE RESTING OPTIMAL ROVERis aimed at inspect and checking of corrosion and crack for the industrial purpose, as well as reducing the cost of product of inspection operation.Vector Is like a robot. It moves vertical and horizontal. It is a simple design. Vector is controlled by Arduino. It is the main component of the project. Vector finding the cracks and corrosions in the metal surface .it moves vertically with the help of brushless DC motor .It fights against the gravity by the propeller .The propeller rotates at high RPM to stand in vertical position .Vector contains Maximum one kg .The vector finds the cracks and corrosion by the thermal sensor. The Rover is used in metal based industry. In industry,labors are affected by the ultrasonic wave but Rover can easily work in the ultrasonic radiation.

The aim of this project is to design a corrosive test on the wall of the biomass boiler or furnace which gets affected due to the oxidation or reduction of the metal. The oxidation or reduction occurred with the chemical reaction which leads to the loss of production and development of the sector. The different types of corrosion that affects the metals are uniform corrosion, pitting corrosion, crevice corrosion, erosion corrosion, galvanic corrosion, environmental cracking and fretting corrosion. These types of corrosion can be detected by using a device called

VECTOR (Vertically Enhanced Corrosive Testing Optimal Rover).The vectors are used in large and medium scale industry

LITERATURE REVIEW

(WALL CLIMBING ROBOT)

➤ INTRO BY GECCO:

If you want to make a wall climbing robot like GECCO but want to adapt the design (add wheels, camera, or use different materials, parts...) you will have to do a little calculation (not hard!).First you'll need to know the mass of the robot. I managed to estimate the mass quite accurate by summing up the masses of the parts of the robot (don't forget the mass of the fan too). I got: $m = 800$ gram.For the friction coefficient for rubber on concrete I found: $\mu = 0.6$ (you can argue with the use of this number) With this we can solve the equation.

$$F_s = (0.8 \text{ kg} * 9.81 \text{ N/kg}) / 0.6 = 13,08 \text{ N}$$

➤ INTRO BY COUNTRY LINDER:

Researchers from Zhejiang University in China have created a new kind of vacuum suction unit to help wall-climbing robots traverse over any kind of surface.Traditional vacuum suction devices fail on rough or textured surfaces due to vacuum leakage. The new suction method looks to solve this problem.The research was published earlier this month in the scientific journal Physics of Fluids.

DESCRIPTION OF EQUIPMENTS

Construction of this device is consist of frame, magnetic wheels, motor, Arduino, L298 driver, transmitter and receiver, battery, control unit are the main components used to complete this setup. This construction can move vertically using magnetic wheels and efficiency of the device depends on the sensor control unit to check the corrosion and it can be controlled by the presence of transmitter and receiver in a precise manner. This simple device can save heavy boiler body from corrosion and damages of metal bodies.

METAL BODY:

Rover body is made up of fabric material which has light weight and carries the control unit of the system. The purpose of the rover frame isto carry and protect the electronic components and instrument. The body of the rover consist of brushless motor, Arduino, L298 driver, transmitter and receiver, battery,a vacuum suction pump at the center of the body

BRUSHLESS MOTOR:

A brushless motor is a direct current (DC) electric motor that operates without the mechanical brushes and commutator of a traditional brush motor. It has distinct advantages over a

brush motor and is more economical in the heavy duty, although the initial costs are higher. Brushless motors are used in various aspects of trenchless construction.

Brushless motors were made possible with the advent of solid state electronics. The regulation of current, known as commutation, can be handled by software in a brushless motor. Advantages of brushless motors include a higher power to weight ratio, the potential for higher speeds, and electronic control.

The complex and various field of trenchless construction has many uses for electric motors. They may be integrated into large tunnel boring machines or used to power narrow horizontal directional drilling devices. They are also part of power tools that may be present at any construction site. Because of initial costs, brushless motors are more prevalent at professional construction sites than in the hands of do-it-yourself repairmen.



CONNECTING WIRE:

Connecting wires are used to link various components to pass signals from one to another. A jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

There are different types of jumper wires. Some have the same type of electrical connector at both ends, while others have different connectors such as follows:

- Solid tips
- Crocodile clip
- Banana connector
- XT60 connector



EDF:

Ducted fans, or shrouded propellers, hold promise as a device for high static thrust propulsion systems. When compared to an isolated propeller of the same diameter and power loading, ducted propellers typically produce greater static thrust. The duct reduces losses in thrust from the tips of the fan blades. By varying the cross-section of the duct the designer can advantageously affect the velocity and pressure of the airflow according to Bernoulli's principle.

Ducted fans are used for propulsion or direct lift. In aeronautics, a ducted fan is a thrust-generating mechanical fan or propeller mounted within a cylindrical duct or shroud. Other terms include ducted propeller or shrouded propeller.



LITHIUM BATTERY:

A lithium-ion battery or Li-ion battery is a type of rechargeable battery composed of cells in which lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge and back when charging. Li-ion cells use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode. Li-ion batteries have a high energy density, no memory effect and low self-discharge.

Specific energy

100–265 W·h/kg (0.36–0.875 MJ/kg)

Energy density

250–693 W·h/L (0.90–2.43 MJ/L)

Specific power

~250 – ~340 W/kg

Charge/discharge efficiency

80–90%

Energy/consumer-price

7.6Wh/US\$

US\$132/kWh

Self-discharge rate

0.35% to 2.5% per month depending on state of charge

Cycle durability

400–1,200 cycles

Nominal cell voltage

3.6 / 3.7 / 3.8 / 3.85 V, LiFePO4 3.2 V, Li4Ti5O12 2.3 V

**L298A MOTOR DRIVER:**

This is a medium power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L293 motor driver IC. It can drive 4 DC motors on and off, or drive 2 DC motors with directional and speed control. The driver greatly simplifies and increases the ease with which you may control motors, relays, etc from microcontrollers. It can drive motors upto 36V with a total DC current of up to 600mA. You can connect the two channels in parallel to double the maximum current or in series to double the maximum input voltage.

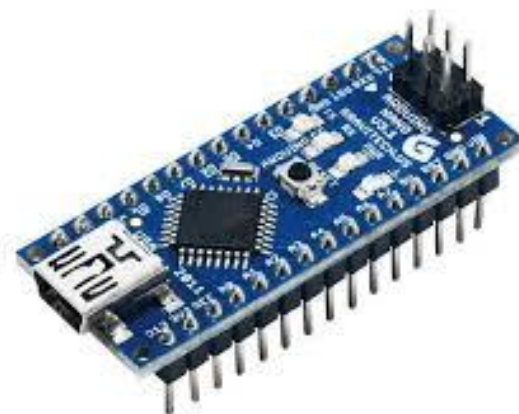
This motor driver uses screw terminals for easy connections, mounting holes for easy mounting, back EMF protection circuit, onboard heatsink for better heat dissipation and more efficient performance. This motor driver is perfect for robotics and mechatronics projects for

controlling motors from microcontrollers, switches, relays, etc. Perfect for driving DC and Stepper motors for micromouse, line following robots, robot arms, etc.

ARDUINONANO:

The ArduinoNANO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.

The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino



WHEEL:

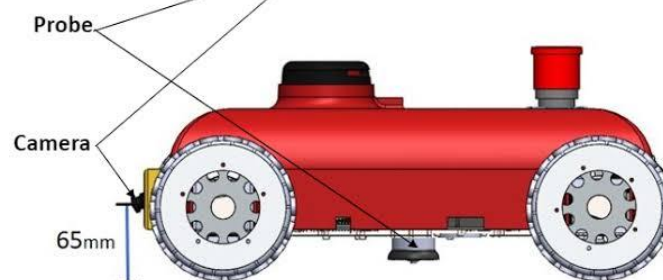
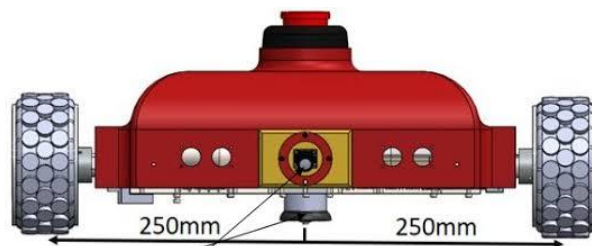
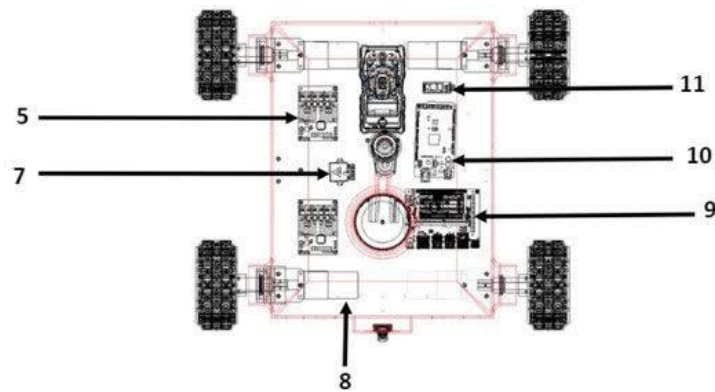
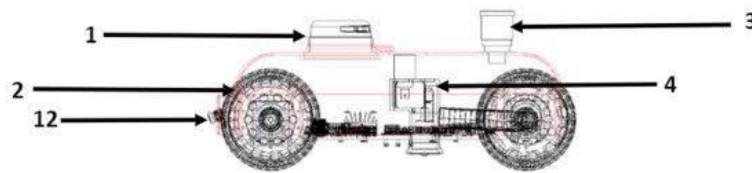
A wheel is a circular component that is intended to rotate on an axle bearing. The wheel is one of the key components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labor in machines.

Wheels are also used for other purposes, such as common examples are found in transport applications. A wheel greatly reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about

its axis, either by way of gravity or by the application of another external force or torque. Using the wheel, Sumerians invented a contraption that spins clay as a potter shapes it into the desired object.



DESIGN AND DRAWING



WORKINGPRINCIPLE

To better understand the equipment selection, it is best to discuss the theory behind the Wall Climbing Robot.

There are several assumptions that must be made: The robot is operating on a dry concrete wall.

- The fan is operating at full power.
- The body of the robot remains completely rigid during operation.
- Steady airflow through the fan.

Mechanical Model

Variables are as follows:

Wall Climbing Robot:

- Creating the Base Distance between the center of mass and surface.
- Half of the length of robot.
- Weight of robot.
- Static coefficient of friction.
- Thrust generated by the fan.

After the base and treads are built, the final step is putting all the parts together. The most important factor is weight distribution. The battery is very heavy so that should be on one side alone. The other components should be placed purposefully to counter the weight of the battery. Putting the electronics on one corner in the middle of the motors is important to ensure the wires meet the motor without the use of additional wires. The connection is the battery and ESC to the fan, this step is very important.

Make sure that the battery and ESC are correctly connected with both positive sides connecting to each other. If they are not connected correctly you risk blowing a fuse and destroying the battery, ESC and the fan. I taped the controller electronic parts on a panel to keep organized, but that part is not a necessity.

ADVANTAGES

- It is simple in design and the compact model allow the rover to pass through the valves of the boilers or tunnels.
- It is safe and secure for the humans to work in chemical or radioactive places.
- It is non - hazardous to the living organism.
- It is more efficient.
- It is easily portable.

APPLICATION

- Its main application is to inspect the surfaces of the boilers and containers that are rusted by the corrosion.
- It is used in the ventilation duct for the visual inspection of the obstacles or damages caused to the surfaces.
- It is used in the concrete wall for external application such as cleaning, painting, etc...

SCOPE FOR FUTURE EXPANSION

We have selected this project to inspect the surface or walls of the boilers and containers. In this we have achieved the vertical climbing movement with holding a device for visual inspection. It is used for a short period of time. We should increase the working time by using the batteries with high milliamps to withstand the rover on the surface for a longer time.

The vacuum duct used in the rover to hold on to the surface is noisy. In future we have to reduce this noise by using alter methods. We should also increase the efficiency of the rover. The rover body parts is developed using advanced combinations of elements to resist and withstand high thermal, radioactive, water resistance and fire resistance. The positioning system will be integrated using advanced level of GPS system to increase the accuracy.

COST ESTIMATION**COST ESTIMATION**

S.NO	COMPONENTS	COST IN Rs
1.	FRAME	200
2.	EDF	2000
3.	ESC	300
4.	BO MOTOR	500
5.	ARDUINO NANO	200
6.	WHEEL	200
7.	TRANSMITTER	3000
8.	PWM RECEIVER	1000
9.	L298A MOTOR DRIVER	200
10.	CONNECTING WIRES	100
11.	BATTERY	1000
12.	CHARGER	300
13.	ACCESSORIES	100

CONCLUSION

We have made a rover which can inspect the corrosion and crack on the walls of the containers or boilers. As considering the cost for inspecting the surface of the boiler by humans, we developed a rover which will reduce the cost and increase the efficiency of the test.

The ultrasonic sensor will send the frequency and receive it by the two main components of the sensor. Ultrasonic sensor is not affected by colour or transparency of objects. It is not highly affected by dust, dirt, or high-moisture environments, where the sensing accuracy is affected by soft materials. It can be used in dark environments.

Thus, the rover is used under the ventilation duct for the visual inspection of the obstacles or damages were caused in the surfaces. As this rover is safe and secure for the humans to work in chemical partitions or radioactive places and the rover pass through the valves of the boilers or tunnels. The compact model made it possible to go through the small containers where man would struggle. The visual inspection can be achieved by the camera and replaced by the ultrasonic sensor. However plans to incorporate maneuverability and other functions can be implemented after the first stage of the development achieved successfully.

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PHOTOGRAPHY

