Developing Simple Wall Climbing Robot Using Microcontroller

Shubham Gurav[1], Dipika Mhatre[2], Dhanashri Patil[3], Ankush Gund[4]
Department of Instrumentation
[1,2,3,4] Bharati Vidyapeeth College Of Engineering University Of Mumbai – India

Abstract- *The paper describes the development of efficient wall climbing robot which can move on smooth vertical surface. Centrifugal impeller is used to produce low pressure which is useful for proper adhesion on vertical wall surface here four wheel locomotive system is used. One of the challenging task is to develop a light weight robot and locomotion system for effective adhesion an movement of robot on vertical surfaces.*

I. INTRODUCTION

Climbing robot system has been developed rapidly in recent years for verity of applications such as cleaning, maintenance of buildings, inspections, fire rescue, etc. they are mainly designed for the safety of human beings. These systems are basically used where direct access by human operator is not possible. Many climbing devices have already been developed and many of them are under development

A robot situated high on a height, could give significant military insights and also support in hunt and salvage operations. Such a robot could additionally be utilized for unmanned breadths of unfriendly territories.It is also serve as a stage for convey guns and explosives. As far as non military person utilize ,different operations being executed at hazardously abnormal amounts.

The robot's motion is driven by dc motors which are electronically linked and synchronised. Frictional force is required to sustain the robot or to move it on the wall. The vacuum pressure can be used to produce the fixing force to the wall, and wheels are available as parts of the moving mechanism on wide vertical surfaces.

To increase the operational efficiency and to protect human health and safety in hazardous tasks make the wall climbing robot a useful device. These systems are mainly adopted in such conditions where direct access by human operator is very expensive due to hazardous environment.

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II. SYSTEM COMPONENTS

The system consists of

- ATMega 328p Microcontroller
- BLDC motor
- L293d motor driver
- Robot and accessories
- Power and voltage regulating Ics
- Switches.

Microcontroller ATMEGA 328P is used mainly for controlling action. The ATmega328P is a single-chip microcontroller created by Atmel in the megaAVR family . It has a Harvard architecture 8-bit RISC processor core.It has 2Kbytes of internal SRAM and 1 Kbytes of EEPROM. It has programmable watchdog timer with separate onchip oscillator.Operating voltage of this microcontroller is +1.8V to +5.5V.

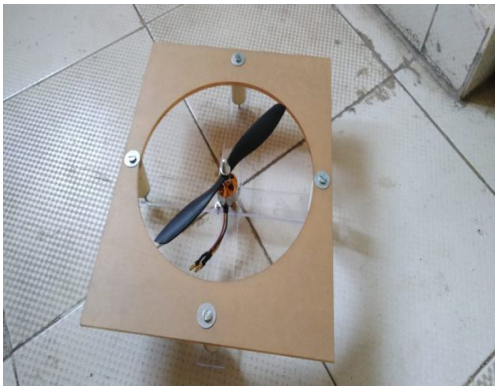
A motor converts supplied electrical energy into mechanical energy. Brushless DC motors provide high efficiency and excellent controllability. The BLDC motor has power-saving advantages .

L293D is a typical Motor Driver IC which allows DC motor to drive in anyone direction. L293D is a 16-pin IC which can control a set of two DC motors at the same time in any direction. It means that you can control two DC motor by

using a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

Robot chassis is made up of acrylic sheet and wheels.

Vacuum fan is used for adhesion of robot on wall.



7805 IC, a member of 78xx series of fixed linear voltage regulators used to control fluctuations. It is a popular voltage regulator integrated circuit (IC). In 78xx, this xx pair indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply.

Switches are used for providing direction to the robot.

ADHESION AND LOCOMOTION MECHANISM

a.Adhesion mechanism

Adhesion mechanism is one of the most important feature of wall climbing robot due to which it can stick to vertical surface without any failure. To develop a proper adhesive force centrifugal impeller is used which works on vacuum created by high speed of impeller.

b. Acrylic sheet

Here acrylic sheet is used as main body part of the robot which is lighter that wooden material. This sheet is capable of holding the robot on the wall with the centrifugal impeller.

c.Locomotion mechanism

It is one of the major part of the wall climbing robot due to which it can move on vertical surface. If we used the legged locomotion system , the speed of the robot will be very slow. On the other hand wheeled type locomotion system can make the robot simple and easy for its operation.

III. CIRCUIT DIAGRAM

Atmega 32 8 p microcontroller has total 28 pins. In that 14 pins are digital input output pins, two of the pins are for crystal oscillator this is to provide clock pulse for at mega cheap.

Clock pulse is needed for synchronisation so that communication can occur between Atmega chip and device.

The Atmega chip needs power , two of the pins vcc and GND provide it power so that it can operate.

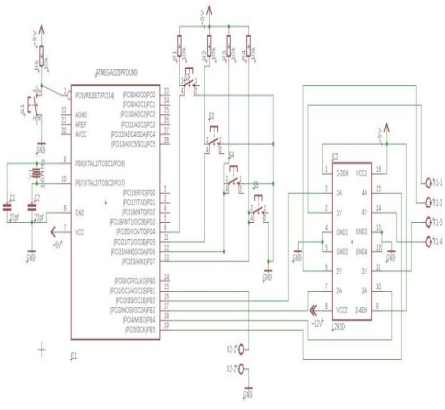


Fig :Ciruit Diagram

L 293 D is a motor driver IC which allows DC motor to drive. It is 16 pin IC which can control a set of two DC Motors in any direction.

IV.AREAS OF APPLICATION

Here are some areas of application:

- Inspection of bridges.
- Transportation of goods and loads inside the buildings.
- Testing in industrial structures such as power plants and pipelines.

- For security purpose like reconnaissance in anti-terrorist activities.
- Cleaning operations in tall buildings, ship hulls and boiler walls

V. PROCESS FLOW

Designing of Robot Model
Calculation of vacuum required for Adhesion
Mounting of motors on chasis
Downloading the program in ATMega 328p
Testing the working of Robot

VI. ADHESION FORCE CALCULATION

Robot have to stick on the vertical surface for that minimum adhesion force is required. From the centrifugal impeller vacuum pressure is created and due to difference between atmospheric pressure and negative pressure robot can stick on the wall properly. In wall climbing robot four wheeled locomotion system is there and adhesion is created by the centrifugal impeller

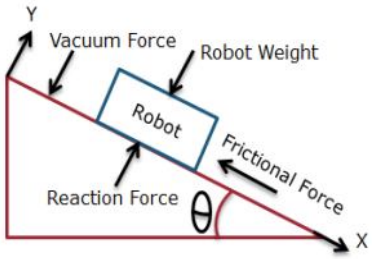


Fig.2 Free body diagram

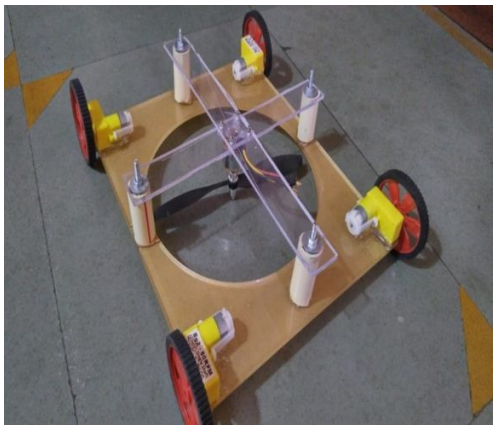
To hold the robot on the vertical wall required suction force can be analysed from the free body diagram as shown in figure 2. we can analyse all the forces acting on the wall from 0 to 90 degree vertical direction. Free body diagram consist of robot weight, vacuum force, frictional force, reaction force. Vacuum force is exerted by the centrifugal impeller due to pressure difference. Frictional force is exerted due to irregularity on the wall surfaces. Robot's weight is depends on the robot mass (M) and acceleration due to gravity (9.81 m/s2) in downward direction.

we can calculate the vacuum force required from the following equation.

$$\mu(F_{vacuum} + M*g*\cos\theta) = M*g*\sin\theta$$

VII. RESULTS AND DISCUSSIONS

Final model is pictorially represented in following figure-



WORKING MODEL

FUTURE SCOPE

This type of robots can take place of humans to carry out hazardous work such as cleaning of skyscraper building , inspection of hazardous area, etc.

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