



iJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5

Issue: IX

Month of publication: September 2017

DOI:

www.ijraset.com

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Review of Glass Wall Cleaning Robot Using Wireless Technology

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Abstract: *In the project, we develop a small wall climbing robot which is used for the cleaning of high glass walls. The main aim is to develop a robot that can clean exterior glass surface of tall buildings efficiently and rapidly even in dangerous and hazardous places. It must follow the following demands: 1) climb on the vertical glass walls with the help of suction cups. 2) Along with climbing it should clean the glass walls with help of woollen roller. This all demands are carried away with the instructions given through the mobile (user) to the Arduino kit. Here we make a wireless connection between the user and the robot by using a zig-bee device. The range of the zig-bee device is maximum 1000m. To stick the robot on the vertical glass surface we have seen different adhesion technique like suction adhesion, magnetic adhesion, electrohuk adhesion etc. But here we use the suction adhesion technique. In which we required the suction cup, the pressure of the suction cups is controlled by using the compressor.*

Keywords—Arduino kit, Zig-bee, suction cups, Mobile Application

I. INTRODUCTION

Now a day the robot provides various services to human to relieve human beings from hazardous jobs like fire rescue, in the military field, inspection of high pipes etc. The glass wall climbing traversability is important for robotic operation such as cleaning of the glass, inspection of walls of tall buildings. Our project is based on a climbing robotic system used to clean glass walls of tall buildings. The climbing robotic system is very challenging work for human being. In this project for the climbing of robot on vertical glass walls we use the suction cups which are operated on pneumatic force and controlled through the compressor. A suction cup is the most important part of the robot for gripping of the robot with glass wall. A negative pressure is applied to the suction cup. For giving pneumatic force to the suction cups the air compressor or vacuum pump is used. Instead of the air compressor or vacuum pump we can use the injection syringe operated by DC motors to apply the negative pressure. The mechanical structure is designed by considering the corners as well as the edges of the glass walls. The material used for the designing of the mechanical body is very light weight metal which can overcome the gravitational force using the negative force applied by the suction cups.

This project contains two main sections. The first and most important is motion of the robot on the vertical wall and second is to clean glass wall properly. The motion section consists of the nine suction cups, solenoid valves, two DC motors, Rack and pinion. And for the cleaning we use the woollen roller.

II. LITERATURE SURVEY

Following paper are used for this project

A. Development of Wall Climbing Robot

Ritesh G. Mahajan and Prof. S. M. Patil explained, the Wall Climbing Robot (WCR) having capability that it can stick on a vertical as well as inclined surface and can easily move over the surface. The targeted capability to stick with surface can be achieved by suction cups. Suction cups create a vacuum pressure used to stick with vertical or inclined surface. For movement (climbing) of robot it is necessary that some of suction cup should release & that arrangement is obtained by developing the structure such that in which one frame is used to hold the robot to wall & other for climbing (vertical movement of robot). The motion of the other frame is carried out by providing rack & pinion type mechanism. The whole action is controlled by an arduino and the commands sending on the Zig-bee through the mobile [1].

B. Design And Development of a Climbing Robot for Several Applications.

Avvaru Subramanyam, Y. Malikarjuna and S. Suneel explained that, A suction cup, also sometimes known as a sucker is an object that uses negative fluid pressure of air or water to adhere to nonporous surfaces. And the climbing robot should be sucked to the surface on which it is climbing safely and overcome its gravity. That is the first difference between a climbing robot and an ordinary

walking robot on the ground. The robot should have a function to move in both the up-down direction as well as the right-left direction to get to every point on the glass. Once the task signals are sent by the user, the robot should keep itself attached to and move on the surface, to meet the requirements of all kinds of functions, precise motion control is needed. The precise position control of the movement will begin automatically as soon as the signals are received. [2].

C. Development of small legged wall climbing robot with passive suction cup

Soichiro Kawasaki, Koki Kikuchi explained that, the weight is proportional to the mass, i.e., the length cubed, the smaller the body size, the more advantageous it is for vertical wall climbing. From this viewpoint, the passive adhesive mechanism is suited to a small wall climbing robot moving with a few degrees of freedom (DOF). In particular, a passive suction cup has unique characteristics such as the edge of the suction cup is detached easily and the suction cup exerts far larger adhesion force than pushing force to attach it [3].

D. Development of small-size window cleaning robot by wall climbing mechanism

In this paper we studied about that, there are two units in the robot. One is for motion of the robot and other is meant for cleansing purpose. The motion of robot is achieved through motion unit. The motion unit comprises of 2 rotating discs, suction-cups, DC motor. Every additional climbing strategy or principle that is explored, improved or tested can increase the probability that a suitable method could be found for a (future) climbing task [5].

III. PROPOSED WORK

As shown in the block diagram of figure 1, an Arduino kit controls all the required actions. A wireless hand set is used to control the directions of the robot in all four directions. Instead of creating a robot direction control keypad we are going to develop software for giving the directions to robot. We are going to interface the mobile software with the zig-bee. This will give the all required instructions to the Arduino kit. An arduino will control all DC motors to operate motion of robot. The motion of the robot is done by using the Rack and pinion. Rack and pinion is used to conversion of rotational motion of the DC motor to the linear motion of the rack. The pinion is a small gear mounted on the shaft of DC motor and the Rack is a linear bar having number of teeth. The DC motor will rotate the pinion and then it will transfer the power to rack. Then rack will perform vertical as well as horizontal motion. Feed the robot body at the bottom of glass wall. Now power on for ready to access commands/instructions. Woollen roller starts rotating to clean the wall. Instructions are given to the assembly via mobile. Instructions are like up, down, right, left, and stop. Up & down: Vertical Rack & Pinion starts working as per coding behind that. Vertical motion is carried out. Right & left: Horizontal rack and pinion will start working and moves in horizontal direction.

Starts cleaning of glass wall from the top of the wall to the bottom in zig-zag manner. Suction cups are used to stick robot on the wall. This is done by applying and removing air pressure into suction cups.

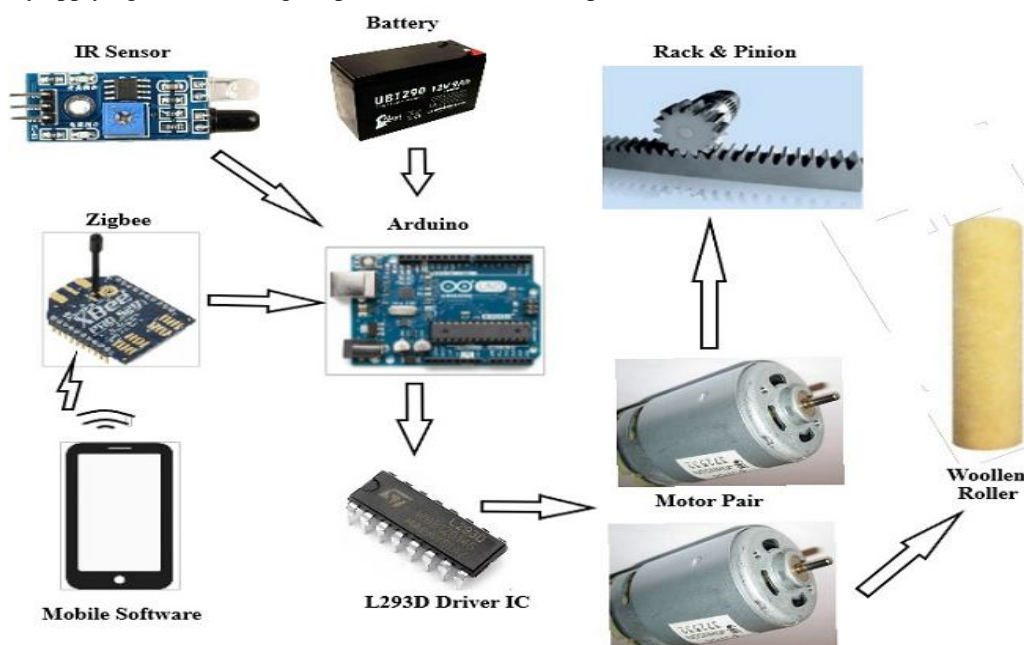


Fig.1 Working And Operation

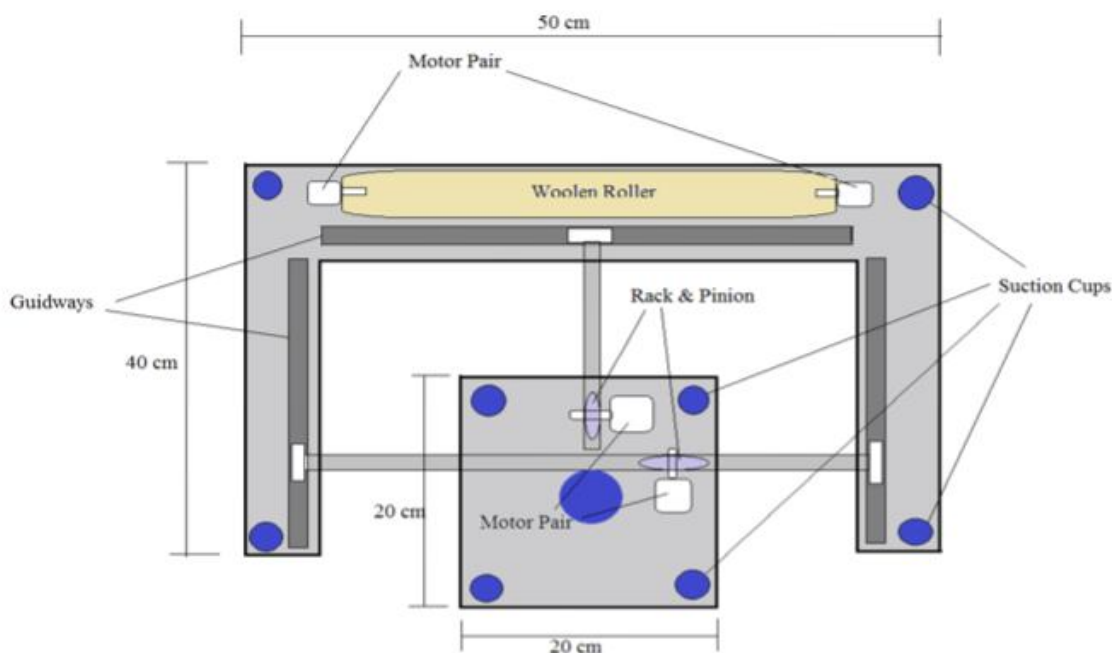


Fig 2. Top view of Robot

A. Mobile Application

The mobile application is designed such that it gives the commands to the arduino kit. In that the direction of motions are entered. The motion of the robot will be in up-down or left-right as per the users need. The commands send through mobile application to the zig-bee placed in the circuit.

B. Suction Cups

This are generally made up of the elastic materials like rubber or soft plastic. Suction cups works on the pneumatic force(vacuum). Suction cups are used to hold the glass wall to stick on that. The climbing action takes place by the suction cups is simple and safe as compare to other techniques used for climbing. Suction cups is the connection between the glass wall and robot body.

C. Zig-bee

The zig-bee is the wireless language that everyday devices used to connect one another. It is low cost and low powered mesh network. It is widely used for controlling and monitoring applications where it covers the distance 1000m range. It is more convenient than other short-range wireless sensor network such as Bluetooth and wi-fi. In this project, the commands and instructions are get fetched with body of robot through the mobile App.

D. Arduino kit

Arduino kit is designed by using the variety of microcontroller and microprocessor. This board consists of set of analog and digital input/output(I/O) pins that can be interface to various components used in this project. In this project, the mobile App(User) sends the commands or instructions to the Arduino board via zig-bee.

E. Rack and Pinon

The rack and pinion is the part which converts the rotational motion into the linear motion. The rotation of the shaft can be done using the dc motor and the horizontal motion of rack is obtained.

IV.CONCLUSIONS

This project will be used at the high rising buildings having the external as well as internal glass wall for cleaning those glass walls. It can be used for another application like painting a wall, monitoring the conditions of the glass walls etc. This glass wall cleaning robot will very useful at colleges, institutes, hospitals, companies, etc.



V. ACKNOWLEDGMENT

We would like to express my thanks to project guide of this paper. We also thanks to all faculty, parents & friend for valuable suggestions and Consistent encouragement.

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