SCREEN ESCALATING ROBOT FOR GLASS WINDOW CLEANING

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Abstract—For cleaning a single large windowpane, wall climbing robot is design. Cleaning the glass surface of window a wiper is attached to the front panel of robot. The climbing robot comprises of two limbs. Each limb has two suction cups. The suction cups are used to stick on the surfaces. The two limbs are connected to the servo motors, one for each. The air removal in suction cups is done by using vacuum pump. Up, down, left, right movements are controlled by microcontroller. Gears and joints are used to convert the rotational motion of the servo motor to the linear motion of the suction limbs. After cleaning, the wiper switches off and then climb as per the instruction given to the microcontroller. The entire platform can find application in wall cleaning for high rise building, wall painting application ,may be used for glass cutting if load handling capability is increased, wired or wireless video surveillance, sensing application like weather monitoring station etc.

Keywords- Climbing Robot, Servo Motor, Suction cups, Vacuum adhesion.

I.INTRODUCTION

Various robots have been designed for climbing applications, cleaning, surveillance and maintenance in the recent past. Currently there are some different kinds of kinematics for motion on smooth vertical surfaces multiple legs, sliding frame, wheeled and chain track vehicle.There are also four different principles of adhesion used by climbing robots: like vacuum suckers, negative pressure, propellers and grasping grippers. The robots with multiple-legs kinematics are too complex due to a lot of degrees of freedom. The kinds of robots which use vacuum suckers and grasping grippers for attachment to the buildings do not meet the requirements for miniaturization and low complexity. Generally the kind of robotic construction and control is very complicated, and does not offer the high efficiencyand simple operation required by a wall cleaning robot.

Ritesh.G.Mahajan et al.[3]Climbing robots are useful devices that can be adoptedin a variety of applications like maintenance, building, inspection and safety in the process and construction industries. These systems are mainly adopted in places where direct access by a human operator is very expensive, because of the need for scaffolding, or very dangerous, due to the presence of an hostile environment. Recently, there have been many demands for automatic cleaning system on outside surface of buildings such as window glass by increasing of modern architectures. Some customized window cleaning machines have already been installed into the practical use in the field of building maintenance.However, almost of them are mounted on the building from the beginning and they needs very expensive costs. Therefore, requirements for small, lightweight and portable window cleaning robot are also growing in the field of building maintenance. As the results of surveying the requirements for the window cleaning robot, the following points are necessary for providing the window cleaning robot for practical use:

Guido Belforte et al.[1] The study and production of robots for domesticapplication is a relatively recent research field. This kind of robot is actually in continuous development. Huge surface cleaning, and even glass windows or building walls is on study in industrial fields with very different characteristics and innovations. Our target is to build a wall-climbing robot for window cleaning application.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 8bit microcontroller[2] .

II.METHODOLOGY

A.Suction Cups

Zhang H. et al.[6] 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. They exist both as artificially created devices, and as anatomical traits of some animals such as octopuses and squid. The working face of the suction cup has a curved surface. When the centre of the suction cup is pressed against a flat, non porous surface, the volume of the space between the suction cup and the flat surface is reduced, which causes the fluid between the cup and the surface to be expelled past the rim of the circular cup.When the user ceases to apply physical pressure to the centre of the outside of the cup, the elastic substance of which the cup is made, tends to resume its original, curved shape.

B.Servo Motor

A Servo is a small device that has an output shaft. This shaft can be positioned to specific angular positions by sending the servo a coded signal. As long as the coded signal exists on the input line, the servo will maintain the angular position of the shaft. As the coded signal changes, the angular position of the shaft changes. In practice, servos are used in radio controlled airplanes to position control surfaces like the elevators and rudders. They are also used in radio controlled cars, puppets, and of course, robots. servos are extremely useful in robotics. you can see the control circuitry, the motor, a set of gears, and the case[4]. you can also see the 3 wires that connect to the outside world. one is for power (+5volts), ground, and the white wire is the control wire.

C.Vaccuum Pump

Air Compressor/Vacuum Pump is used to create a very low pressure end to suck the air inside the suction cups with the help of reservoir. It operates on 230 volt AC supply.

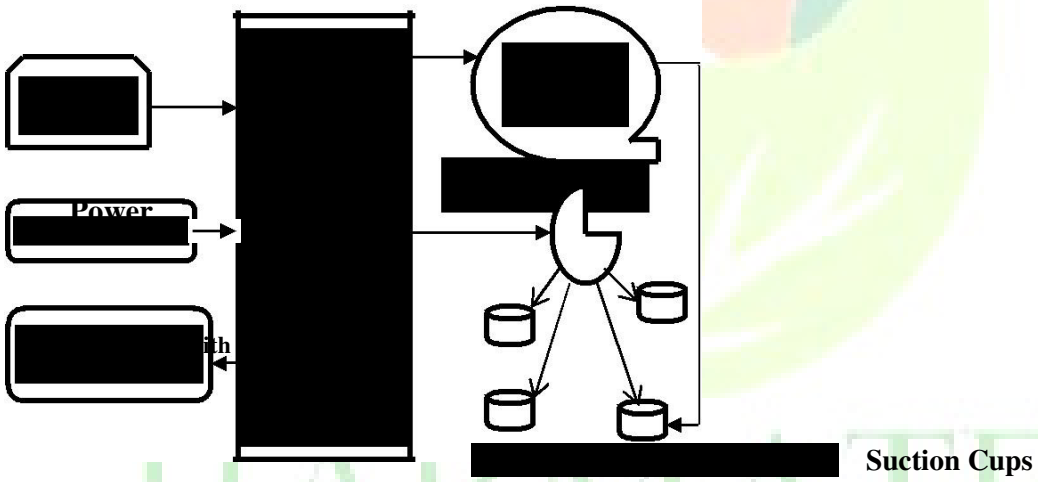

Fig 1: Block Diagram of Escalating Robot

III.WORKING PRINCIPLE

As shown in the block diagram Fig-1, a microcontroller controls all the required actions. A wireless hand set is used to control the direction of the robot in all four directions. The corresponding LED flashes to indicate the direction. The signals are sent and received using an RF transceiver. An LCD display is facilitated to display the sensed values sent by the microcontroller of the climbing robot. When the direction control signals are received by the microcontroller, it acts according to the program written in the memory. When we power up all the electronic circuits initially, a piece of code will be executed in the microcontroller to make the robot limbs stick to the walls by removing air in the suction cups. In order to do that, air compressor/ vacuum pump must be turned on. So the relay 3 in the diagram will be activated to power up the air compressor. Now it's the turn of the solenoid valves to open and let the air to be sucked by the compressor. Therefore relays 1 and 2 must be activated to provideelectricity to the

solenoid valves. Now the four suction cups are stuck to the surface, usually a wall. In order to make movements, the controller receives the direction controlling signals from the user's handset. Controller, now executes the piece of code to free one limb i.e., one pair of suction cups by letting air into the suction cups, from the air reservoir. For this controller needs to turn off the air compressor by de activating the relay3. Now one limb is free to move up and down[1]. Now controller provides the specified movement with the help of servos. After achieving the required movement , now again the free limb i.e the pair of suction cups need to stick on. For this, air compressor must be turned on by activating the relay3. In the similar fashion the other limb of the climbing robot can also be controlled to move up and down by the microcontroller. The joints which are connecting the limbs with the servos plays a vital role.

IV.RESULTS AND DISCUSSIONS

This presents an application of a climbing robot for the glass cleaning service. The robot is constructed by using two frames, Suction cups & Motor, Injection barrel.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. Future work will be toward developing more efficient motion control system and reducing size/weight of the climbing robot.

Fig 2: Wall Climbing Robot

V.CONCLUSION

As expected, the results of the project came out to be satisfactory and the important observations are summarized as follows. The robot is facing difficulty in climbing the normal surfaces where air leakage is a problem. The robot is facing difficulty in climbing more than 90^0slant angle on walls. Compared to normal walls, it is working fine on glass walls and wooden walls. Wireless camera placed on the robot body is transmitting good quality video output up to 10 m. Direction control headset is working fine and properly transmitting the navigation (Up, Down) signals and also receiving the sensor data effectively. Similarly the robot is receiving the direction control signals and changing the directions as expected up to a distance of 100 ft. he suction mechanism is working satisfactorily. The temperature sensor placed on the robot body is also functioning properly.

VI.APPLICATION

With little or no modification, the climbing robot can be used for the following applications and also its advantages are mentioned.

1. It can be a replacement for GONDOLA system for high rise building cleaning .
2. Has the potential to serve as a base on which to mount data acquisition devices, surveillance equipment, or object-manipulation tools .
3. Wireless/wired video surveillance possible .
4. public safety & military applications (surveillance, search & rescue) .
5. Consumer applications(window cleaning and painting) .
6. Inspections (building, aircraft & bridges, Pipes) etc.

7. Wall/glass cleaning and water sprinklers can be mounted .
8. On board vacuum cylinders are not used, which increases payload capacity.

VII.FUTURE SCOPE

On close observation, the climbing robot can be further enhanced in many ways. They can be listed as follows.

1. Payload can be increased by increasing the pumping capacity
2. Robot weight can be reduced.
3. Elevation angle of the robot on walls can be enhanced.
4. Leg stroke can be improvised.
5. Robot movement Speed on walls can be increased.
6. Obstacle detection can be added.

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