PNEUMATIC POWERED WALL CLIMBING ROBOT FOR DUST CLEANING PURPOSE IN A HIGH RISK BUILDING'S

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ABSTRACT

This Paper Presents a Wall Climbing Robot for Cleaning of Dust Particle in high risk buildings. The facade cleaning of high risk building by human operator is not safe. The development of a mobile robot which can move on the vertical or overhanging walls of tall buildings, on the side walls of ships etc., has been expected for a long time. The robot could then be utilized to carry rescue tools or does some other works instead of human. To increase operation efficiency and to protect human's we designed a wall climbing robot for cleaning application. The gripping is required to sustain the robot or to move it upwards on the wall. A magnetic force or vacuum pressure can be used to produce the fixing force on the walls and wheels or crawlers are available as parts of the moving mechanism on flat and wide vertical surfaces. A climbing robot with suction cup is more attractive since it can move on a large irregular surface. The microcontroller Atmega2560 is implemented for control application. While climbing in the vertical wall obstacle like windows opening, grills in the walls are detected by using the obstacle sensor.

KEYWORDS: *Atmega2560, vacuum cup, vacuum adhesion module, suction cup*

I.INTRODUCTION

The development of a mobile robot which can move on the vertical wall or inspection of oil tanks, maintenance of high risk building construction, surveillance on the side walls of ships, etc., has been expected for a long time. The robot could then be utilized to carry rescue tools or to do some other work instead of human. In order to realize this robot, frictional force to the wall, and wheels are crawlers are available as parts of the moving mechanism on flat and wide vertical surfaces.

A walking robot with suction cup is more attractive since it can move on a large irregular surface. Many combinations on these ideas can be developed for various applications in the near future. In this paper a suction cup with a vacuum pressure is created for climbing and locomotion. A small amount of air is sucked from the peripheral clearance of the cup, when it is moving on the wall, when the brush and/or flexible skirt are employed to prevent air flow at the periphery of the cup. To increase the operation efficiency and to protect human health and safety in hazardous tasks make the wall climbing robot a useful device. These system are mainly adopted in hazardous environment or need of scaffolding. The vacuum adhesion module will make the robot to seal the suction in smooth manner.

The climbing robot should be sucked to the surface on which is climbing safely and overcame its gravity. This is the first difference between a climbing robot and an ordinary walking robot on the ground. The wall climbing robot on safe and reliable attachment to the surface and they have ability of crossing obstacles. The system component of an automatic façade robot influence each other great deal and cannot be considered as independent parts. The following are key to all façade robots are independent of the building shape and façade type are

mechanics, kinematics for movements along the façade control system, sensor, navigation, and operator interface means for safeguarding the robot against falling, supplying energy and cleaning materials to the robot cleaning device.

With this configuration, it is possible for the robot to climb both discontinuously along the surface, while avoiding obstacles and nonetheless maintaining contact with the surface with as many vacuum grippers as possible. The façade cleaning of a wall climbing robot is used for inspection of high risk building construction. The external sensor used in the robot will detect the obstacle in the glass wall and overcome it. The trajectory planning is controlled by manually while climbing in the vertical wall. The above section will discuss the hardware and software description.

II. HARDWARE IMPLEMENTATION

The atmega2560 AVR microcontroller is used for designing the wall climbing robot. The robot is manually controlled by zigbee remote control. Based on the command given by the zigbee remote control the robot will drive the movement. The crank mechanism is based on the vacuum pressure created in the compressor. The air is extracted from the vacuum compressor and is given to the volume occupied by space between vacuum cups and wall. The gripping mechanism is implemented with the vacuum cup. The dust in the vertical wall is extracted by vacuum pump in the vacuum compressor. When the obstacle is detected the robot will rotate the passion from the other position.

III. HARDWARE COMPONENTS

3.1 ATMEGA256O

It is high performance low power consumption 8-bit advanced RISC processor of eighty six programmable I/O lines, 32 eight bit general purpose working registers with operating frequency of 16Mh. The eighty six I/O lines is flexible to interface the peripheral devices. It is a high endurance non-volatile memory segments. 256 kilo-bytes of in-system self-programmable flash memory, 4 kilo-bytes of EEPROM, 8 kilo-bytes of internal SRAM. Two eight bit timers, four 16 bit timers, twelve PWM channels with programmable resolution from 2 to 16 bits, four programmable serial USART for communication through zigbee.

3.2 SUCTION CUP

The flat suction cup is used to stick the cup in the vertical wall flexible gripping so the robot will not fall or slip. It is easy attachment in the due to the small volume of air to be evacuated. They are excellent for use on fast cycle transfer system for vertical lifting.

3.3 PNEUMATIC VALVE

The pneumatic valve are used to control the pressure of compressed gases as well as the rate and direction of flow. This in turn controls the action of the device using the compressed air or gas. The pressure is applied through the pneumatic valve to stick the suction cup in the vertical wall and depressurize in the suction cup for next movement.

3.4 IR SENSOR

This sensor is a sharp detection of nearby object. The analog ranger provides the information of distance to an object in the rangers view. The digital detectors provide a digital indication of an object at or closer than a predefined distance.

IV. ROBOT MOVEMENT

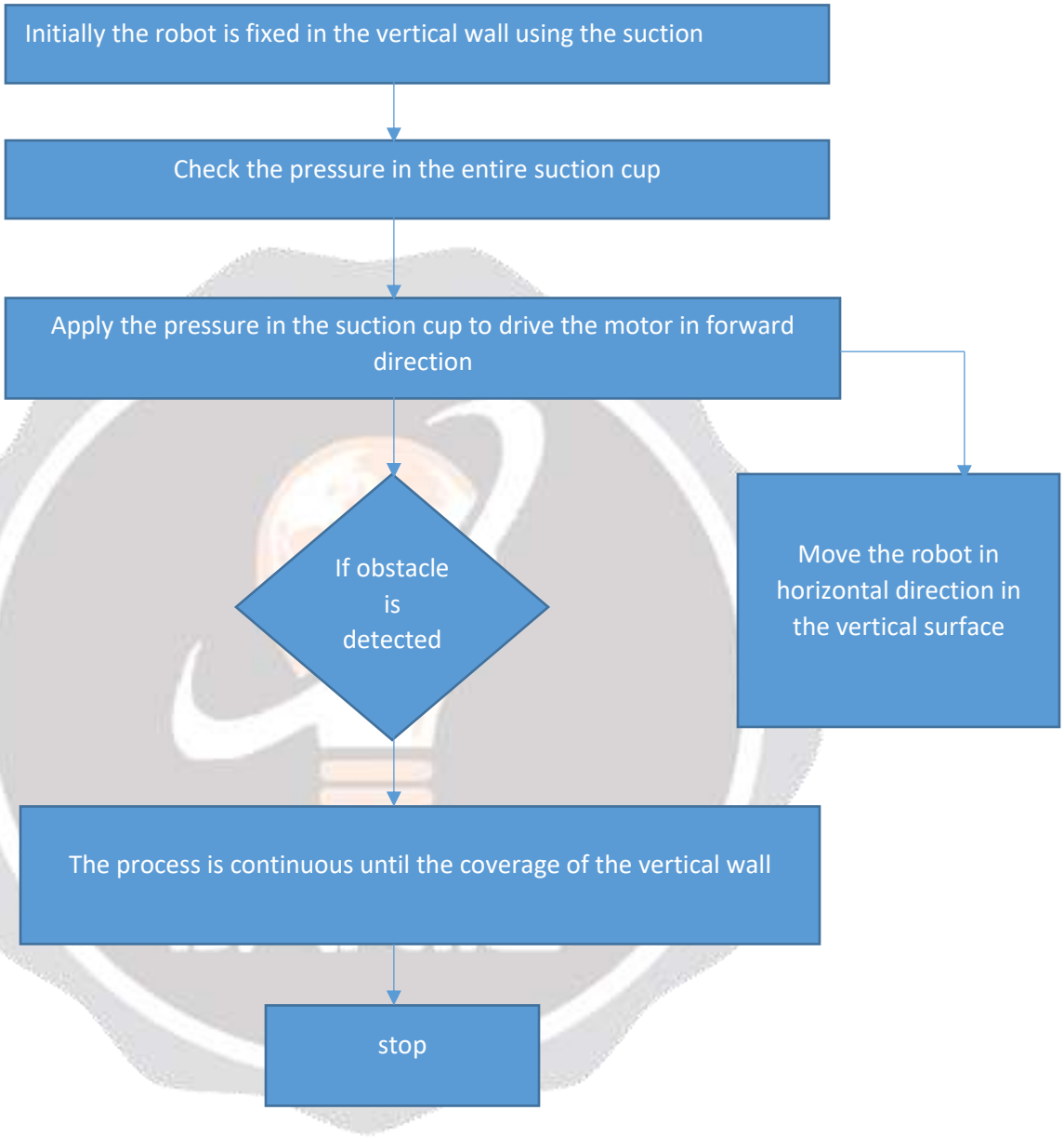

Fig-1 Flowchart for robot movement

Initially the robot is fixed on the wall using the suction cup. To move the robot in the forward direction depressurizes the suction cup using vacuum compressor. Once the suction cup is depressurized we have to stick the robot for next movement again pressurizes the suction cup for some delay. The robot will continue the process for forward and reverse movement. While climbing the robot in the wall if any obstacle is detector sensor the robot find the obstacle, turn and in the forward direction.

V. CLEANING OF DUST PARTICLE

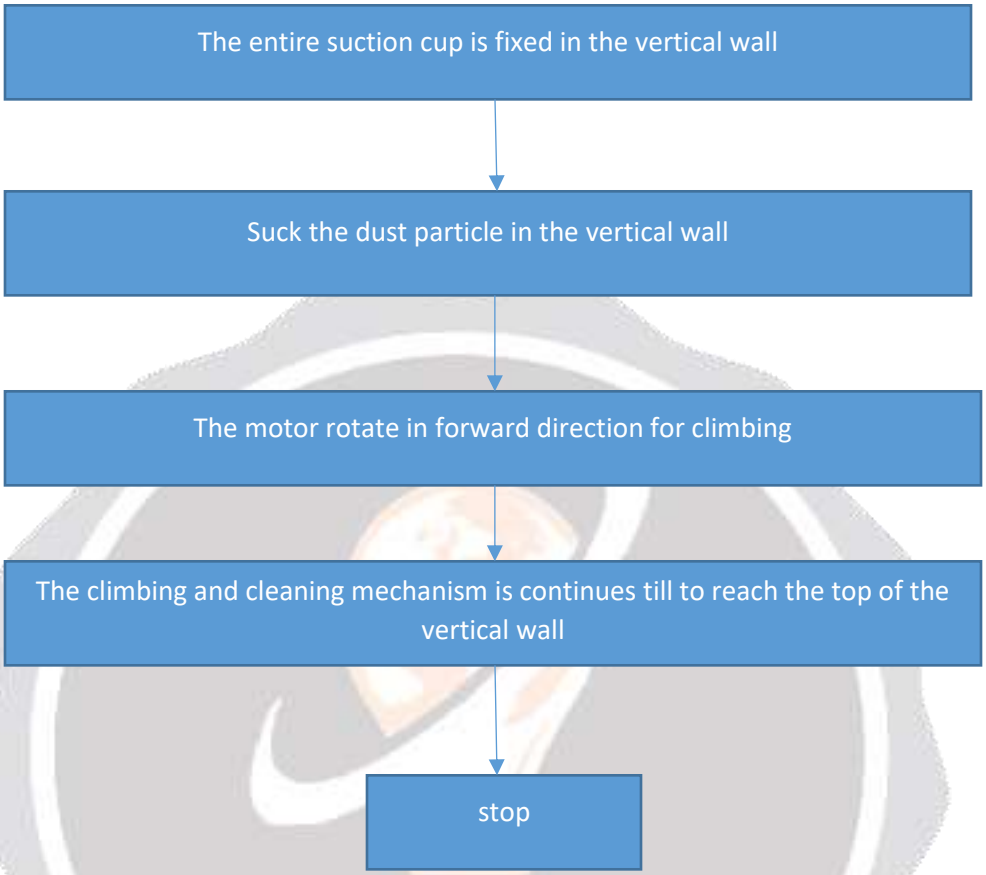

Fig-2 Flowchart for cleaning mechanism

VI. BLOCK DIAGRAM

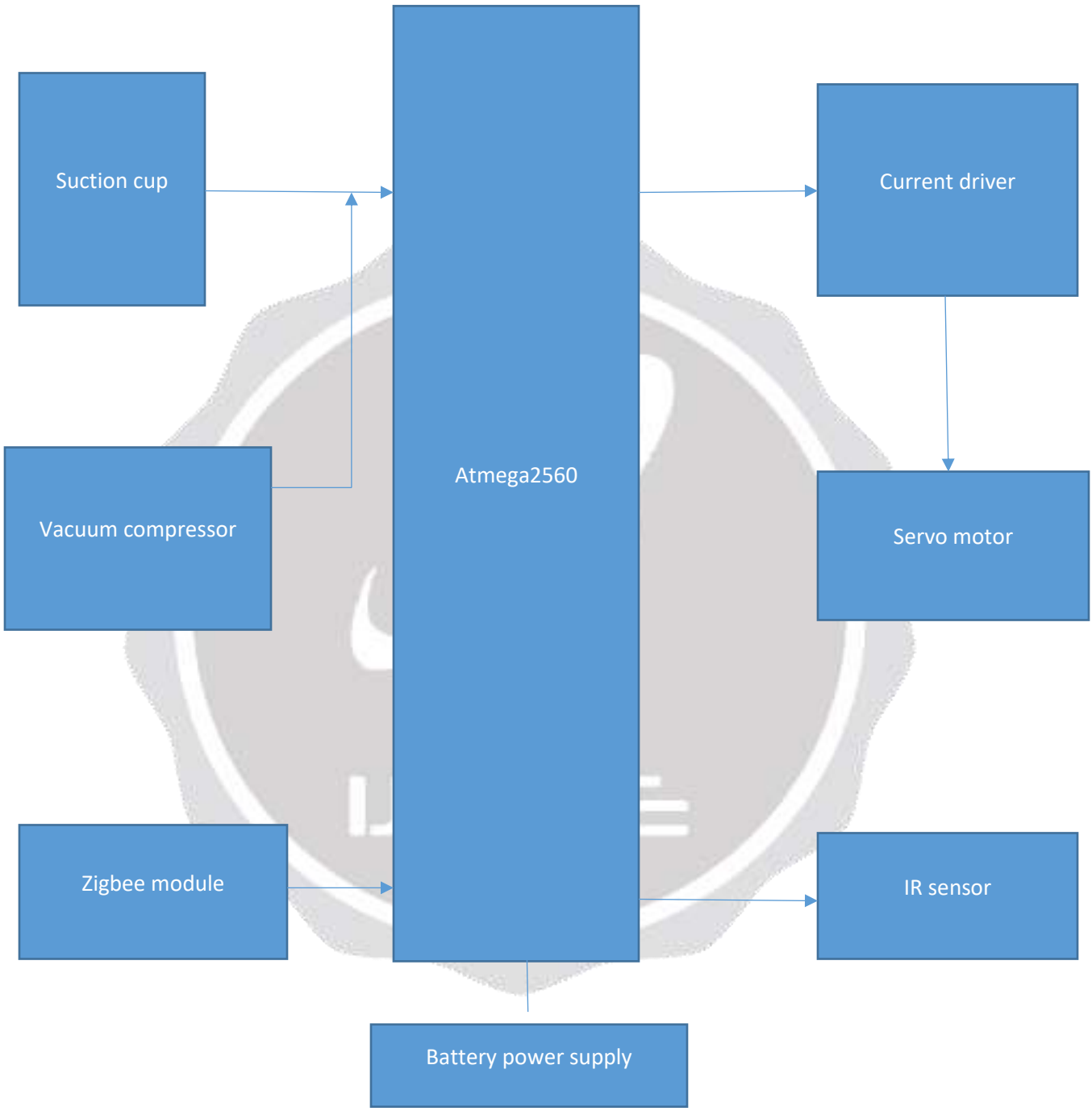

Fig-3 Block diagram

VII. RESULT AND DISCUSSION

The developed prototype wall climbing robot with inspection camera and accessories. The robot is tested in real time and capable of transverse without any slide or drop off. Though the weight of the robot proposed is limited to 1k.g, it can be enhanced by increasing the suction cup diameter and suction rate of the vacuum generator. It helps to identify the region of the robot. It represents the robot in holding condition and not allow to slide. Robot in about to fall off condition and helps to estimate the minimum holding force of the suction cup.

VIII. CONCLUSION

There are several applications the wall climbing robot is using in different locomotion and adhesion. Based on the application the adhesion mechanism is used. The researchers using the various techniques for climbing and adhesion, the suction cup adhesion give the better and flexible gripping in the vertical wall. This simpler, compact and light weight robotic platform provides a safe and effective means to deal with hazardous duty operations. Within the mechanical area our robust platform, it is developed to climb on relatively smooth surfaces and non Porous surface. Thus the important factors of using wall climbing robot for the following reasons, they are such as follows,

- It is used to climb the wall safely and overcome it's gravity, should avoid the human injuries.
- To reduce the human effort.
- Time consumption for dust cleaning purpose in a high risk building's.

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