iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** II **Month of publication:** February 2020

DOI: http://doi.org/10.22214/ijraset.2020.2071

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

Welding Inspection Robot

Ariya Manickam. M[1], Sree Vathsan .Y[2], S. K. Thangarasu[3]
[3]*Assistant Professor,* [1,2]*II*[nd] *year, B. E .Mechatronics Engineering, Kongu Engineering College, Perundurai, Erode-638060.*

Abstract: ***A Robot field is developed vastly over the past decade. Motivation of a climbing robot with the ability to maneuver on vertical surfaces is to increase the operation efficiency in dangerous environments or places which are dangerous for human beings where safety measurements are too important. The invention of vertical surface climbing robots are one of the evolving fields in the area of robotics and many of these wall climbing robots are used in applications such as welding inspection, etc., With the advancement of technology, many of climbing robots have been proposed for various applications like cleaning in hazardous environments such as nuclear reactors or spray painting on roofs, where human safety is into very risk. All these robots are developed by using different types of techniques like: vacuum suction, magnetic or electromagnetic force, or gripping with claws. Every technique has some positive points and restrictions. For instance, magnetic adhesion can be used for a strong base for a high safety purpose, but is used only for ferromagnetic surfaces and for iron surface. Second technique, suction adhesion is based upon a complete vacuum with the surface, walking on porous & non- porous surfaces. The proposed system is to make a robot which can climb easily on wall and preferably on any type of wall and it will detect welding defects.***
Keywords: 1.Wall climbing robots using vaccum suction,magnetic track system climbing robot, Dc gear motor, Servotester, Lithiumiron rechargeable battery, Cmos camera .

I. INTRODUCTION

The objective of the project is to eliminate the difficulties and complications involved in existing wall climbing robot used in shipbuilding industries for inspection system and providing an low cost wireless control robot for performing the inspection of the ships in shipbuilding industries figure(1.1).

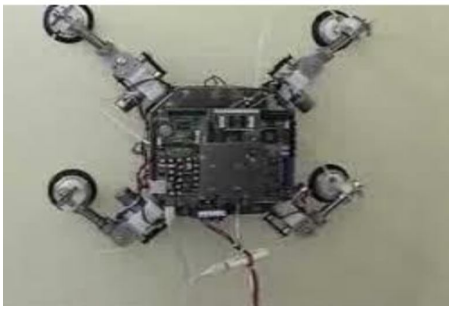


Figure 1.1 Wall climbing robots using vacuum suction.

II. LITERATURE SURVEY

A. Existing System

The wall-climbing robot currently existing targets on ship inspection, so other excessive functions of general robots are excluded. The robot consists of modules including the magnetic track system, control system, holder for detector and the robot body structure. Since ship hull mostly made of steel is often uneven due to welding deformation, the permanent magnetic is chosen as the adhesion and locomotion type. Its track is driven by a motor. Since a special holder is designed to carry different detecting instruments and allows the robot to perform ship inspection in various occasions, its payload capacity is increasedaccordingly.

Figure 1.2 Magnetic track system climbing robot.

1) *Magnetic Track System:* The existing robot is made to stick with the wall and maneuver over the wall by using either electromagnetic force or magnetic force. While electromagnetic adsorption has the advantages of great adsorption edge and easy control, it can only be applied on the ironic surface [6]. Magnetic adhesion has been implemented in wall climbing robots for going on ferrous surface and for specific applications such as nuclear facilities inspection. Making tracks of ferrous material makes it cost ineffective and nonfeasible and can't be used in hazardous conditions.

B. Drawbacks

1) since magnetic track drive is used it can move only in metal surfaces
2) High cost of magnetic track drive
3) Cannot be used
4) Since it is a wired system operating is complex for high heights
5) They are using RGB camera so it takes large time for processing and transmission time also Slow.

C. Proposed Solution

In this proposed project, the robot uses the principle of aerodynamic suction to hold the robot with the wall surface and the differential drive powered through DC gear motors is used to move the robot on the surface which will overcome the difficulties of the existing system and also it will detect the crack and welding defects .

1) *Advantages*

a) The proposed model will be Low cost solution for the specified purpose than the existing model As there is no magnetic traction system employed it can move on all the surfaces
b) Can move on both vertical wall and ceiling .

2) *Disadvantages*

a) Battery Backup.
b) Pressure difference When there is a hole in the surface.

D. Working Principle

Concept of aerodynamics is used in the same way as applied in helicopters in uplifting A control uplifting against the wall is done here which is a good approach to make a robot to climb on vertical wall but this technology has a major limitation that it can't sustain weight. To uplift a robot using small sized blades, its weight need to be very low. Hence the proposed system was designed in such a way that the whole weight of the robot must not exceed 1.5Kg. Air blower fan used in the proposed robot was run by BLDC controlled through ESC. It has plastic blades which rotates at high rpm (16000rpm) and creates high suction against the wall surface. The movement of the robot on the wall surface was achieved by means of a conventional differential drive. DC gear motors controlled by driver IC was used to have a differential drive. The CMOS camera was mounted on the front of the robot and the receiver was connected to computer for inspection. Ultrasonic sensor fixed in front of the robot was used as safety precaution to stop the robot when any obstacle presents in the way of the robot. We are using MATLAB and Open CV software for Image processing. We are using Grey code camera so processing time will be reduced and it occupies low memory. We are Using CNN Structure So processing will be Fast and accurate. We are trained for some defects like Porosity, Undercut, Arc strikes, Spatter, Excessive reinforcement, incomplete joint penetration.

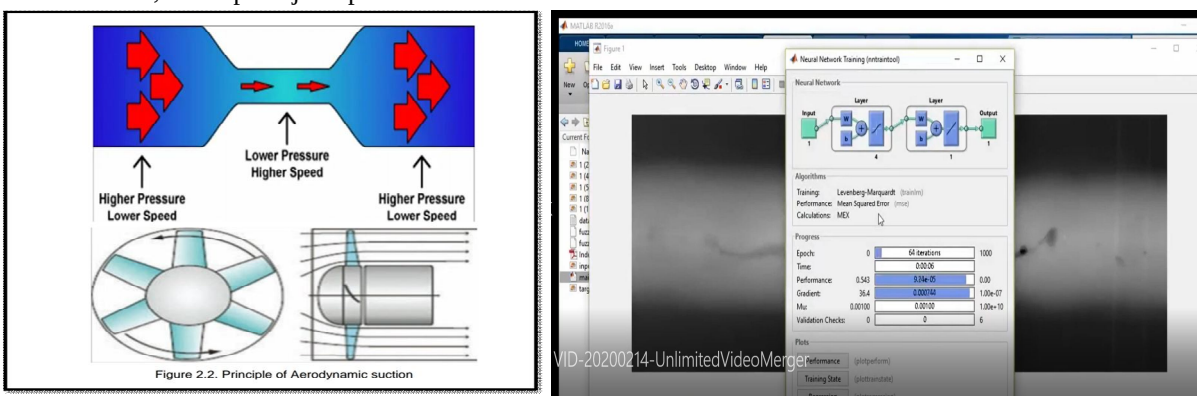


Figure.1.3

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

III. FEASIBILITY STUDY

Feasibility study is an important process in development of any product which helps to discover the strength and weakness of the proposed model, opportunities and threats to it by the environment and resources required for making the product successfully. 3.1 ECONOMIC FEASIBILITY The cost estimation of the project is shown in the Table 3.1.

A. Economical Feasibility

S.NO	NAME OF THE COMPONENT	SPECIFICATION	COST
1	DC gear motors(4)	12V,100rpm,5kg cm	1200
2	Brushless DC motor with ESC(1)	2.4kv,12V	750
3	Servo Tester(1)	12V input	350
4	Arduino UNO(1)	AT mega,328P	450
5	Lithium-Ionrechargeable Battery(1)	12V,2.2 Amps	550
6	Ultrasonic sensor(1)	5V input,0-5V output	100
7	Acrylic sheet(chassis)	15cm*10cm*3cm	250
8	ESP 8266 Wi-Fi module(1)		450
9	Blower Fan(1)	Diameter=7.2cm	150
10	Relay module	Single point relay	80
11	Cmos Camera with Receiver	2MP,6mm lens	250
12	L293D driver IC	Vcc=5V	150
13	OtherMiscellaneous(wires,tags)		250
		TOTALCOST	Rs.4,980

Figure (3.1)

From the cost estimation it was found that the proposed project is economically feasible.

B. Operational Feasibility

Since the project aims to create a wireless robot using some of the basic components and controlled by using smart phone, its operation is simple and easy to control.

C. Technical Feasibility

Since the proposed system replaces the magnetic traction system currently used with a simple blower fan and also fabricated by using basic engineering components and basic principle of aerodynamic suction the proposed system will be technically possible and feasible to implement real time.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

IV. DESIGN SPECIFICATION

A. *Components Description*

1) *DC Gear Motor:* A DC motor is a mechanically commutated electric motor and it is powered from direct current (DC). The stator is remains stationary in space by definition and therefore the current in the rotor is switched by the commutator to also be stationary in space. This makes the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque. DC motors have a rotating armature winding but non-rotating armature magnetic field and a static field winding or permanent magnet (Theraja et al, 2006). Different connections of the field and armature winding provide different torque /inherent speed regulation characteristics

A DC Motor is shown in the Figure 1.4.

Figure 1.4 DC gear Motor

2) *Micro Controller:* A microcontroller is refers to a small computer and it has integrated circuit consist of processor core, memory, and programmable input/output peripherals. Program memory is in the form of NOR flashes or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Micro controllers plays a vital role in embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. Figure 1.5 shows an 89C51 microcontroller. Among the manufacturers of microcontroller Atmel company is the leading company. ATMEGA328 microcontroller is used in the project, with ARDUINO platform as shown in fig, a 28 pin IC. Microcontrollers are used to control the system and used in automatically controlled products and devices, such as automobile engine control and

it plays a vital role in a control system.

Figure 1.5 Arduino-UNO (ATMEGA328 Microcontroller) Systems.

3) *Brushless DC Motor with ESC:* Brushless DC electric motor (BLDC motors) also known as electronically commutated motors (ECMs, EC motors), or synchronous DC motors, are synchronous motors powered by DC electricity via an inverter or switching power supply which produces an AC electric current to drive each phase of the motor via a closed loop controller. The controller provides pulses of current to the motor windings that control the speed and torque of the motor. The construction of a brushless motor system is typically similar to a permanent magnet synchronous motor (PMSM), but can also be a switched reluctance motor, or an induction (asynchronous) motor. The advantages of a brushless motor over brushed motors are high power to weight ratio, high speed, and electronic control. Brushless motors find applications in such places as computer peripherals (disk drives, printers), handheld power tools, and vehicles ranging from model aircraft to automobiles. BLDC motor An electronic speed control or ESC is an electronic circuit that controls and regulates the speed of an electric motor. It may also provide reversing of the motor and dynamic braking. Miniature electronic speed controls are used in electrically powered radio controlled models. Full-size electric vehicles also have systems to control the speed of their drive motors. An electronic speed

control follows a speed reference signal (derived from a throttle lever, joystick, or other manual input) and varies the switching rate of a network of field effect transistors By adjusting the duty cycle or switching frequency of the transistors, the speed of the motor is changed. The rapid switching of the transistors is what causes the motor itself to emit its characteristic high-pitched whine, especially noticeable at lower speeds.

Figure 1.6 BLDC motor

4) *Servo Tester:* A servo tester is work by controlling of PWM(Pulse With Modulation) signal.it is an electronic device it is used to move the servo to the entire range of motion .The button in the tester is allow to control the signal . The accuracy and range is determined by the servo tester.
5) *Lithium-Ion Rechargeable Battery:* Lithium-ion polymer battery is widely used in many science application. Lithium-ion polymer battery has more life span when compare to other types of battery and it possess more density and it will possess low discharge rate when compared to other rechargeable battery and it provide high current density
6) *Ultrasonic Sensor:* Ultrasonic sensor is used for measuring distance and detect any obstacle which is present in front of the sensor and the roll of ultrasonic sensor is huge in the field of automation. In my project i used this sensor for detecting obstacle in the wall and it is determined with the help of echo pulse.

Figure 1.7 Ultrasonic Sensor

7) *ESP 8266 NODEMCU Wi-Fi Module:* NODEMCU is an open source IOT platform. Which is used to interface the hardware component and the microcontroller. Which run on the ESP8266 WIFI SOC and it is based on ESP-12 module . Lua is a language which is used to program a module. storage capacity is about 4MB and a memory capacity is about 128KB and it is powered by USB port and developer of the module which we are used is ESP8266 open source community and it provide enormous connection. Majorly this module is used in many IOT projects.
8) *Relay Coil:* Relays mostly uses electromagnetism concept for switching the relay mechanically. Also they are employed in controlling several devices with single control signal.
9) *CMOS Camera with Receiver:* Complementary Metal Oxide Semiconductor camera it is used to capture grey code image. We are using CNN structure because of fast processing and it takes only small storage. We are only receiving the image with the help of camera. Further processing will be held on computer.
10) *L293D Driver IC Module:* L293D is a IC driver motor which makes the DC motor to operate in any direction. L293D IC consists of 16 pins with that we can able to control two DC motors at a time in both directions. It means with the help of a single L293D IC we can control two DC motors. It uses H-bridge principle .which consist of a circuit that allows only voltage to pass through in either direction. As we know that the motor has to run in clockwise and anticlockwise direction we need to change the direction of voltage. Hence this IC uses the H-bridge concept.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

B. Design Calculation

1) Mass of the Components

Material used = Acrylic sheet
Density = 1.2×10^-6 Kg/mm^3
Frame = 0.19Kg
Motor mass = 0.52Kg
Blower Fan = 0.24Kg
Battery = 0.27Kg
Camera = 0.08Kg
Controller = 0.18Kg
Total mass(W) = 1.48 Kg ~ 1.5Kg
14

2) Holding Force Of A Suction Blower

Blower Fan Speed = 16000 RPM
Pressure = 5.5 KPa
Radius of Fan = 3.6 cm
Suction Area = πr2
=π*3.6*3.6 = 40.71 cm2

$$\Delta P = (5.5\text{-}1.01) = 4.49 \text{ KN/m2} = 0.449 \text{ N/cm2}$$

$$F = \Delta P * A = 0.449*40.71 = 18.27 \text{ N} \quad 4.2.3$$

3) Vertical Lifting Force And Motor Torque

Total weight of Bot = 3 kg
FOS = 2
Acceleration = 9.8.1m/s2
Force = ma = 3*9.8= 29.43 N
Torque = Force*distance
Torque = 29.43*0.003
= 0. 08829 .Nm (or) 0.9 kg.cm 4.2.4

4) Speed of The Robot

Radius of the wh.eel = 35mm = 3.5 cm
Speed = 10 rpm .
Distance covere.d by wheel in one rotation = 2πr = 21.98 cm
Speed =10 *21..98
= 219.8. cm/min =3.66 cm/sec
10……..5

5) *Microcontroller Specification*: Manufacturer: ATMEL Model no : ATMEGA38 Memory : 32k bytes (flash) I/O ports : 28 RAM : 2K bytes Timers : Two 8bit and One 16 bit
6) *Electronic Relay Specification:* Type: Single point relay Coil voltage : 5 V/DC Operating voltage : 250 VAC/10A---28VDC/10A

V. FABRICATION PROCESS

A. CAD Modelling

Designing is the most important stage of any product. This design is made with the help of solid works software. Initially the part drawings are made to the dimension specified and then the parts are assembled as shown in figure 1.8. The reason for choosing solid works over AutoCAD is the fact that the ease with working in the former one. Figure 1.8 depicts clearly mention the motors and blower actuation step by step

Figure 1.8 Solid Works Mode

B. Electrical Section

The electrical section consists of Microcontroller circuit, ESP-8266, Relay circuit and Driver circuit. All the circuits are built on a dot board except the microcontroller circuit which is built using a microcontroller development board. The ESP-8266 which is used for wireless control. Relay board has relays which converts the signals from the microcontroller to actuating components.

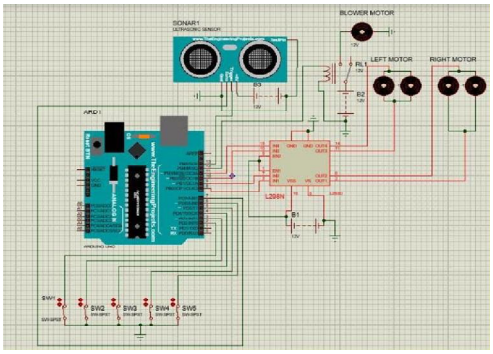


Figure 1.9

C. Fabrication Setup

As a whole consists of both mechanical components and electrical components integrated. The mechanical section consists of chassis which forms the base of the prototype on which the DC geared motors and electronics system can be placed. The mechanical section consists of 4 wheels in total, 2 wheels in the front and two wheels at the rear, the DC gear motor are attached to the chassis with wheels. A suction fan is fixed in the centre of the bot, the fan is driven by the high speed Brushless DC motor with the ESC and servo tester. The Electrical components are placed above the chassis of the bot, The Microcontroller Board is attached with the ESP-8266 Wi-Fi module, when we control with the mobile it gives the signal to the microcontroller to move the bot and to control the blower fan. The speed of the blower fan is controlled using the servo tester. In the mobile application there are 5 buttons, 1 button is for controlling the blower fan and other 4 button is for controlling the bot directions in forward, reverse, left and right. The ultrasonic sensor is fixed in the front side of the bot if the sensor senses any obstacles the moment of the bot will be stopped but the blower fan will run continuously. The wireless Camera is attached in the front of the bot to detect the defects/inspection in the industries. The separate receiver is attached in the laptop to view the video of the camera in
Bot. The complete fabricated setup is shown in figure 5.3 and the control screen used in smart phone was shown in figure 1.10

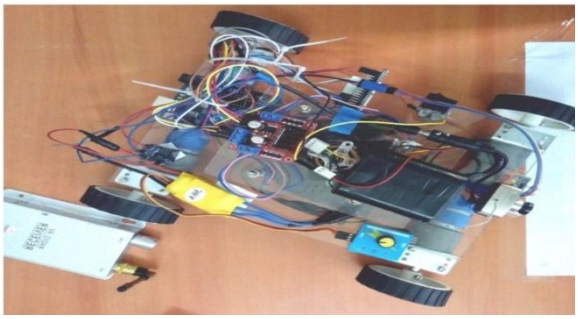


Figure 1.10 Fabricated setup

VI. CONCLUSION AND SCOPE FOR FUTURE

A. Conclusion

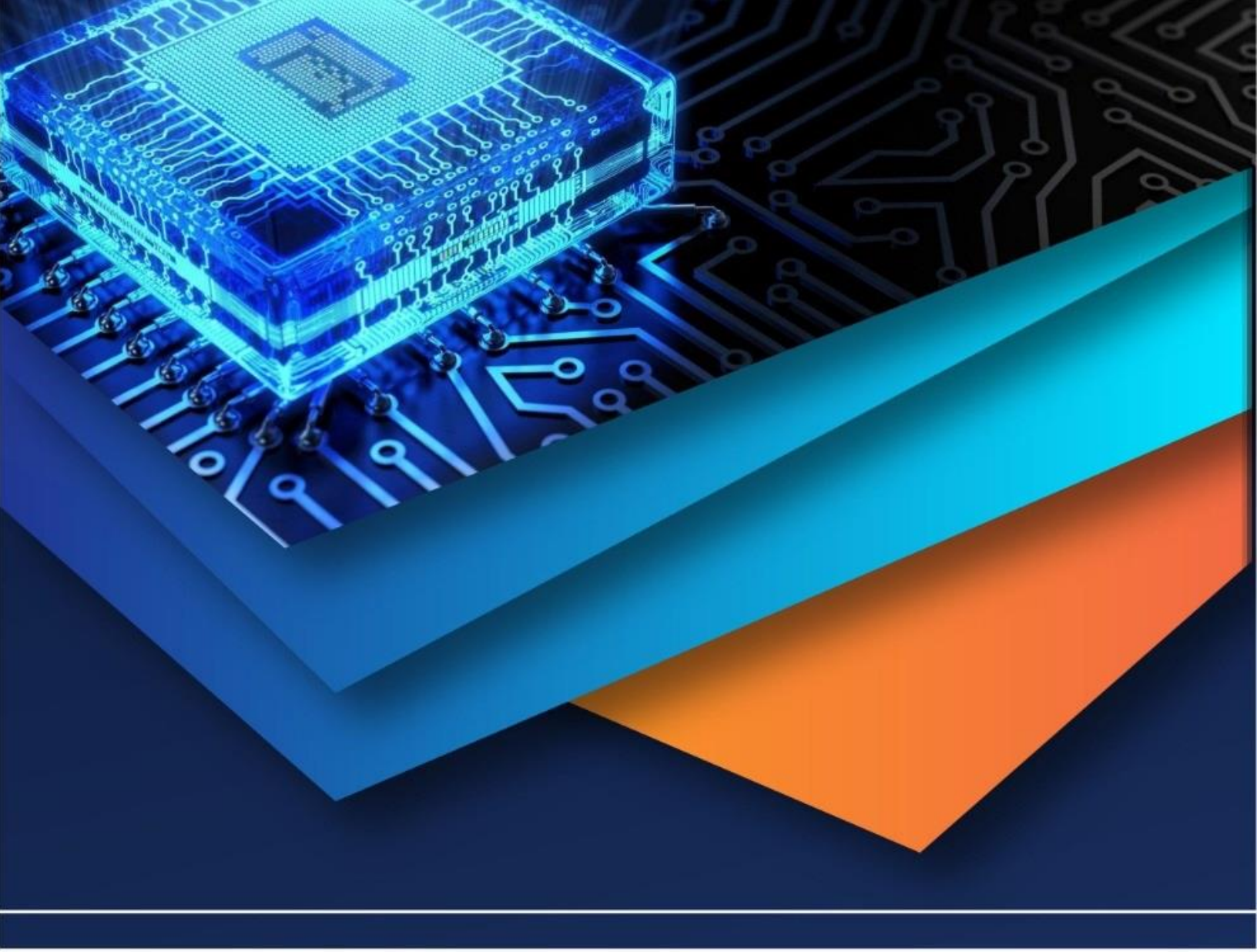
The wireless wall climbing robot developed will be wireless controlled by using smart phones and this will be the low cost solution of its kind thus overcome the disadvantages of the existing system.

B. Future Scope

This system can be further improved by incorporating the movement between the two perpendicular walls effectively. In addition to that the proposed system may be modified for various applications such as cleaning, welding, painting etc.,

REFERENCES

[1] Huang, H., Li, D., Xue, Z., Chen, X., Liu, S., Leng, J. and Wei, Y., 2017. Design and performance analysis of a tracked wall-climbing robot for ship inspection in shipbuilding. Ocean Engineering, 131, pp.224-230.
[2] Sintov, A., Avramovich, T. and Shapiro, A., 2011. Design and motion planning of an autonomous climbing robot with claws. Robotics and Autonomous Systems, 59(11), pp.1008-1019.
[3] Kermorgant, O., 2018. A magnetic climbing robot to perform autonomous welding in the shipbuilding industry. Robotics and Computer-Integrated Manufacturing, 53, pp.178-186.
[4] Chanchlani, R., Swami, S.K.R., Agarwal, R., Sharma, S., Agrawal, M. and Agarwal, R., 2013, April. Intelligent Climber: A Wireless Wall-Climbing Robot Utilizing Vacuum Suction and Sand Paper. In 2013 Texas Instruments India Educators (pp. 271-276). IEEE.
[5] Shen, W., Gu, J. and Shen, Y., 2005, July. Proposed wall climbing robot with permanent magnetic tracks for inspecting oil tanks. In Mechatronics and Automation, 2005 IEEE International Conference (Vol. 4, pp. 2072-2077). IEEE.
[6] Yan, W., Shuliang, L., Dianguo, X., Yanzheng, Z., Hao, S. and Xueshan, G., 1999. Development and application of wall-climbing robots. In Robotics and Automation, 1999. Proceedings. 1999 IEEE International Conference on (Vol. 2, pp. 1207-1212). IEEE.
[7] Hirose, S., Nagakubo, A. and Toyama, R., 1991, June. Machine that can walk and climb on floors, walls and ceilings. In Advanced Robotics, 1991.'Robots in Unstructured Environments', 91 ICAR., Fifth International Conference on(pp. 753-758). IEEE.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY