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Mobile Operated Wall Painting Machine

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Abstract: In the modern construction industry, automation is becoming increasingly essential to improve efficiency and reduce manual labor. This project focuses on developing that automates the wall painting process, ensuring uniformity, speed, and cost-effectiveness. The machine is designed to move along a vertical and horizontal axis, covering large surface areas with minimal human intervention.The system consists of a frame structure, motorized rollers, a paint spray mechanism, and a microcontroller-based control system. Using sensors and programmed algorithms, the machine adjusts the spray pressure, movement speed, and paint flow to achieve consistent coverage. The objective is to reduce human effort, minimize paint wastage, and enhance the quality of the painted surface.This project has significant applications in residential and commercial construction, reducing labor costs and improving workplace safety by minimizing direct human exposure to paint chemicals. Future improvements could include AI-based surface detection, adaptive paint control, and integration with robotic arms for more complex painting tasks.
Keywords: Wall Painting, Mobile Operated, Spray Painting, Semi-Automated

I. INTRODUCTION

Painting walls manually is a time-consuming and labor-intensive task that often results in inconsistent finishes, fatigue, and high costs due to the need for skilled labor. To overcome these challenges, automation in the painting industry is gaining popularity.

The Mobile Operated Wall Painting Machine is an innovative solution designed to automate the wall painting process, ensuring efficiency, precision, and reduced human effort. This project aims to develop a robotic or semi-automated system capable of painting walls uniformly with minimal human intervention. The machine can be programmed to cover large areas quickly while maintaining an even coat of paint, reducing wastage, and increasing productivity.

By integrating mechanical design with automation technologies such as sensors, motors, and control systems, the Mobile Operated Wall Painting Machine enhances the speed and quality of painting, making it an ideal solution for residential, commercial, and industrial applications. This project will explore the machine’s design, working principles, advantages, and potential improvements in the field of automated painting systems.

Working Principle of Mobile Operated Wall Painting Machine

The Mobile Operated Wall Painting Machine mechanizes applying paint to the walls through an integration of pneumatic, mechanical, and electrical components. It incorporates Mecanum wheels to move, DC/Johnson motors for accurate motion, diaphragm pumps to supply paint, and motor drivers to control it.

II. WORKING PRINCIPLE

1) *Mobility & Positioning*

The Mecanum wheels enable the robot to move omnidirectionally for easy positioning in front of the wall.

Motor-driven and powered by DC/Johnson motors, the robot is capable of moving left, right, forward, backward, and diagonally without rotation.

2) *Vertical & Horizontal Movement*

Lead screws and linear bearings assist in accurate up-down and side-to-side motion.

These movements enable the painting mechanism to cover the wall evenly with no gaps or overlaps.

3) *Paint Supply & Control*

The diaphragm pump draws paint from the baffled water reservoir, stopping sloshing and providing a consistent flow of paint.

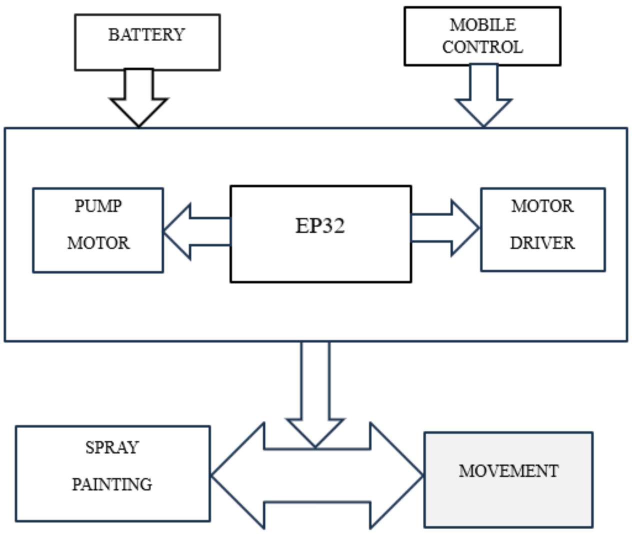
The motorized system controls the paint sprayer/nozzle, adjusting the paint spray for uniform coating.

4) 4. Motor & Electronics Control

ESP32 with motor drivers (TB6612FNG, Smartelex 13A) regulates all motor operations, providing accurate speed and movement. MOSFET (IRF950N) is an electronic switch used to control motors and pumps, switching components on/off as required.

5) Automation & Programming

The system is programmable using ESP32 to operate autonomously, enabling predefined routes and automatic paint coverage. Wireless control through WiFi/Bluetooth enables remote operation.



Block Daigram

III. COMPONENTS

1) Mecanum wheel

Fig.1

Mecanum bus enable omnidirectional movement, allowing a vehicle or robot to move in any direction without changing exposure. This makes them ideal for

- Robotic platforms(automated machines, AGVs)
- Material handling vehicles(storages, logistics)
- Military and deliverance robots(maneuvering in tight spaces)
- Medical outfit(sanitarium wagons, wheelchairs)

How Mecanum Wheels Work

Each mecanum wheel consists of breakers angled at 45 °, which enable the vehicle to move in multiple directions

- Forward/ Backward – All bus rotate in the same direction.
- Sideways(Strafing) – contrary bus rotate in contrary directions.

- Diagonal & Rotational Movement – Different speed control of each wheel enables smooth transitions and reels.

operation in a Wall Painting Machine

A wall oil robot equipped with Mecanum bus benefits in several ways

- Precise Positioning – Moves parallel to the wall for harmonious oil.
- Omnidirectional Movement – Can navigate corners and obstacles fluently.
- Automated Control – Works in confined spaces without taking homemade adaptation.
- Smooth Transitions – Ensures indeed paint operation by maintaining speed and alignment.

2) Diaphragm pump

Fig.2

A A diaphragm pump(also appertained to as a Membrane pump) is a positive deportation pump which employs a combination of the action of prepayment of a rubber, thermoplastic or teflon diaphragm and applicable gates on each side of the diaphragm(corroborate
cock, butterfly gates, distraction gates, or any other type of shut- off gates) in order to pump a fluid.

3) 2 litress Baffled water tank

a) Definition & Purpose

A thwarted water tank has internal walls(baffles) that control water movement, reducing sloshing. This makes it ideal for mobile operations where stability is needed.

b) Uses & Working

- Prevents Water Sloshing – Baffles break the movement of water, precluding insecurity.
- Ensures nonstop Water Flow – Provides a steady water force for spray oil.
- Enhances Paint Mixing – If used for makeup or thinner storehouse, it ensures proper mixing.
- Reduces Air Bubbles – Prevents makeup blights caused by air pockets.

c) operation in a Wall Painting Machine

- Spray System Stores water for makeup dilution or drawing the spray system.
- Cooling Medium Can be used to cool down machine corridor if needed.
- Weight Balance Helps stabilize the oil robot or machine during operation.
- Pressure Control Works with a pump to give a controlled water or makeup inflow.

4) DC motor (45rpm)

Fig.3

A 45 RPM(Revolutions Per Minute) DC motor is a low- speed, high- necklace motor generally used in operations taking slow and controlled stir, similar as

- robotization systems(e.g., conveyor belts, robotic arms)
- Small artificial ministry
- DIY and hobbyhorse systems
- Medical and laboratory outfit
- Wall oil machines

How a 45 RPM DC Motor Works

- Electrical Energy to Mechanical Motion A DC power force energizes the motor, creating a glamorous field that rotates the architecture.
- Speed Control The speed(45 RPM) is maintained using voltage regulation or a motor motorist.
- Torque Generation Due to its slow speed, it provides high necklace, which is useful for controlled movements.

operation in a Wall Painting Machine

A 45 RPM DC motor can be used in multiple ways in a wall painting machine

- Roller/ Brush Movement Controls the movement of the makeup comber or encounter for indeed sheeting.
- Spray snoot situating Moves the makeup sprayer to different areas of the wall.
- Vertical & Horizontal Motion Drives a lead screw or belt system to move the oil unit.
- Automated Arm Control Helps in robotic oil arms for precise movements.

5) JHONSON MOTOR (60 RPM)

Fig.4

A Johnson DC motor is a high- necklace, low- speed motor generally used in robotics, robotization, and artificial operations. A 60 RPM Johnson motor is specifically designed for operations taking controlled and steady stir.

How Does It Work?

- It runs on DC power and uses an architecture, endless attractions, and skirmishes to induce rotational stir.
- Provides high necklace at low pets, making it suitable for perfection tasks.
- Can be controlled using PWM(Pulse Width Modulation) for variable speed control.

Uses & Applications

- Robotics – habituated in robotic arms and movement systems.
- robotization – Employed in conveyor belts, automated machines, and affluents.
- Home & Industrial Equipment – set up in electric drills, selectors, and small appliances.

Operation in a Wall Painting Machine

- A 60 RPM Johnson motor is useful in a Mobile Operated Wall Painting Machine for
- Paint Roller Medium – Controls the smooth and unifor mmovement of the comber.
- snoot Movement – Moves the spray snoot in a controlled manner.
- Robotic Arm Control – Adjusts the arm position for precise wall content.
- Vertical & Horizontal Movement – Helps the oil medium move along the wall face.

6) Linear Bearing

A direct bearing is a mechanical element that allows smooth, low- disunion movement along a straight path. It's used in machines that bear precise direct stir, reducing resistance and icing delicacy.

How Linear Bearings Work

- Linear comportments companion and support moving corridor along a fixed direct axis.
- They use ball comportments or comber comportments to minimize disunion.
- Mounted on a shaft or rail, allowing smooth and controlled stir.

Operation in Wall Painting Machine

In an automated wall oil machine, direct comportments play a pivotal part in guiding the oil snoot or encounter easily along the wall.

They help in

- icing Precision – Allows accurate and indeed paint operation.
- Smooth stir – Reduces vibration and pulls for a professional finish.
- Reducing Wear & Tear – Extends the lifetime of the machine by minimizing disunion.
- Supporting Vertical & Horizontal Movement – Helps the oil head move over/ down and side- to- side.

7) Lead Screw (16 Mm)

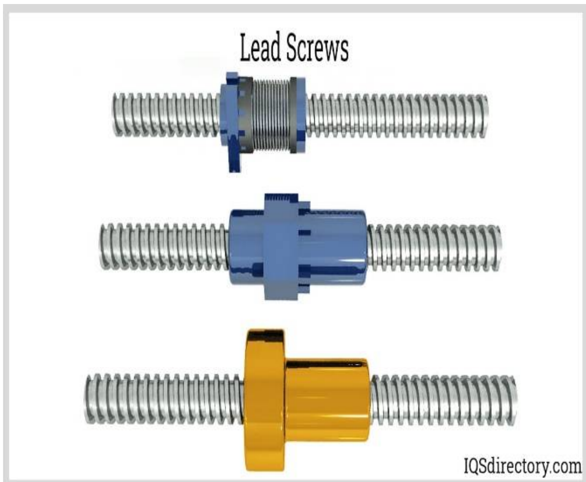


Fig.5

A lead screw is a mechanical component used to convert rotary motion into linear motion. It is commonly used in machines for precise movement and positioning.

How Lead Screw Works:

A rotating motor (stepper/servo/DC) turns the lead screw.
The nut moves linearly along the screw’s axis when it rotates.
This movement is used for precise control of horizontal or vertical motion.

Application in Wall Painting Machine

Vertical Movement: Moves the spray or brush up and down for uniform wall coverage.
Horizontal Motion: Can be used to move the painting head side-to-side.
Precision Control: Ensures smooth and accurate painting without manual errors.
Automation: Works with motors and sensors to follow programmed patterns.

8) Motor Driver EP32

It looks like you meant Motor Driver ESP32 (which is a microcontroller) or possibly L298N motor driver with ESP32. Here's a breakdown of how a motor driver (like L298N) works with ESP32 in a wall painting machine:

Uses and Working of Motor Driver (ESP32-based)

A motor driver is used to control DC motors or stepper motors in the wall painting machine. Since ESP32 alone cannot directly drive motors, the motor driver acts as an interface between ESP32 and the motors.

Working Principle:

ESP32 sends control signals (PWM & direction) to the motor driver.

The motor driver amplifies these signals and provides sufficient power to the motors.

The driver allows controlling speed, direction, and torque of motors.

Application in a Wall Painting Machine

In a wall painting robot, motor drivers are essential for:

- Controlling Paint Sprayer Movement
- Moves the sprayer left-right and up-down using DC motors or stepper motors.
- Wheel & Track Control
- Drives wheels or robotic arms to move the painting machine on the wall.
- Precise Speed and Positioning
- Stepper motors ensure accurate motion for smooth painting.
- Automation & Wireless Control

When used with ESP32, the system can be controlled via WiFi/Bluetooth for remote operation.

Motor Driver Options for ESP32 in Wall Painting Machine

L298N – Good for basic DC motors but less efficient.

TB6612FNG – More efficient for small motors.

A4988/DRV8825 – Best for stepper motors, ensuring precision.

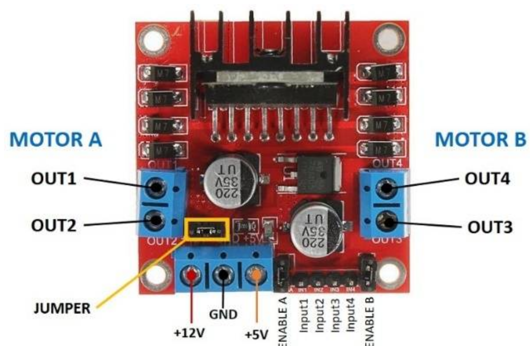


Fig.6

9) Tb6612fng motor driver

- Uses of TB6612FNG Motor Driver

Controls DC motors and stepper motors in robotics and automation projects.

Provides bidirectional control (forward/reverse) for two motors.

Supports PWM speed control, allowing smooth speed adjustments.

Efficient for battery-operated systems due to low power consumption.

- How TB6612FNG Works

It takes control signals from a microcontroller (like Arduino or Raspberry Pi).

Uses H-Bridge circuits to control motor direction and speed.

PWM (Pulse Width Modulation) signals adjust motor speed.

Can handle up to 13V and 1.2A per motor, with short bursts up to 3.2A.

- Application in a Wall Painting Machine

Motorized Paint Sprayer: Controls DC motors to regulate spray nozzle movement.
Automated Brush Movement: Moves brushes for consistent wall coverage.
Wall-Climbing Robot: Drives motors for robots that move along walls for painting.
Conveyor System Control: If using a conveyor to move walls or painting surfaces

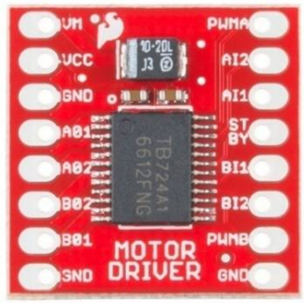


Fig.7

10) Smartelex 13amp motor driver

- Uses of Smartelex 13A Motor Driver:

The Smartelex 13A Motor Driver is used to control DC motors with high current requirements (up to 13A) in robotic and industrial automation applications.

- Working Principle:

It uses H-Bridge circuitry to control the speed and direction of DC motors.
Accepts PWM (Pulse Width Modulation) signals to vary motor speed.
Supports bidirectional control (forward and reverse).
Has built-in overcurrent protection to prevent motor damage.

- Application in a Wall Painting Machine:

Controlling Paint Roller or Spray Nozzle: Regulates motor speed for smooth paint application.
Wall Traversing Mechanism: Moves the painting system along the wall in a controlled manner.
Height Adjustment: Powers a motorized vertical movement for different wall heights.
Automated Arm Movement: Helps position the sprayer accurately over surfaces

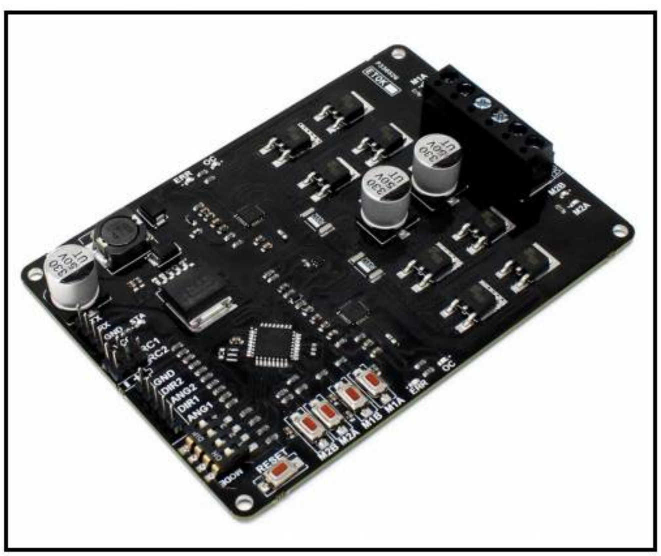


Fig.8

IV. DISCUSSION ANDRESULT:

The study of an automated Mobile Operated Wall Painting Machine is concerned with the incorporation of mechanical, electrical, and pneumatic components to ensure accuracy, efficiency, and labor minimization in painting operations. Omnidirectional mobility is facilitated through the application of Mecanum wheels, guaranteeing easy mobility within narrow areas, while DC motors and Johnson motors power the painting system with regulated speed and torque. A diaphragm pump provides smooth paint flow from a baffled water tank, which eliminates sloshing and enhances paint mixing. The lead screw and linear bearing system provide smooth vertical and horizontal movement, minimizing vibration for uniform paint application. ESP32-based motor drivers (TB6612FNG, Smartelex 13A) manage movement and speed, providing automation and remote control through WiFi/Bluetooth. The IRF950N MOSFET manages motor and pump operations, maximizing efficiency. Though this system benefits with speed, uniformity, and less dependency on labor, surface adaptability, power control, and obstruction detection are among the challenges left to be overcome. Improvements in the future need to revolve around AI-based automation, machine learning optimization of paths, multi-surface adaptability, and IoT-based integration to advance functionality and efficiency. This study emphasizes how robotic automation can transform painting by minimizing human error, maximizing productivity, and providing uniform coverage, ultimately changing construction and interior design processes.
The developed Mobile Operated Wall Painting Machine successfully automates the painting process, reducing human effort and improving efficiency. By integrating Mecanum wheels, DC motors, and linear bearings, the machine moves smoothly across the wall, applying an even coat of paint. The 12V diaphragm pump ensures a steady paint flow, while motor drivers like Smartelex 13A and TB6612FNG provide precise motor control. The system eliminates manual painting errors, covers large surfaces quickly, and ensures uniform paint application, making it ideal for residential, commercial, and industrial use.

V. OBJECTIVE

1) Painting: The machine should be able to paint in a single colour.
2) Ease of use: The machine should be designed to be easy to use.
3) Simplicity: The machine should be simple, light weight, and affordable.

VI. EFFICIENCY

The efficiency of the mobile-operated wall painting machine can be expressed in terms of coverage per unit of time and paint consumption. Here are the key efficiency formulas:

1) Painting Speed (sq. ft. per minute):

Speed = Painted Area / Time = 41.7 sq. ft / 1.58 min = 26.4 sq. ft./min

2) Paint Utilization Efficiency (sq. ft. per liter):

Efficiency = Painted Area/ Paint Used = 41.7 sq. ft./ 2liter = 20.85 sq. ft./liter

3.Paint Consumption Rate (liters per sq. ft.):

Consumption Rate = Paint Used / Painted Area = 2 liters / 41.7 sq. ft. =0.048 liter/sq.ft

ComparisionOf Mobile Operated Wall Painting Machine To Manual Painting Method:

a) Speed & Coverage:
- Machine:
  - Uses 2 liters of paint to cover 41 sqft in 1.58 seconds.
  - This means it covers 26 sqft per second.
- Human Painter (Manual Painting):
  - A professional painter with a roller typically covers 100-150 sqft per hour (assuming high efficiency).
  - This translates to roughly 0.03-0.04 sqft per second.

Machine is nearly 650-900 times faster than manual painting.

b) Efficiency & Paint Usage:
- The machine uses 2 liters for 41 sqft, meaning 1 liter covers ~20.5 sqft.
- A manual painter usually covers roughly 14-16 sqft per liter, depending on technique and wastage.
- Machine is more efficient with paint usage due to precise spraying.

c) Labor & Fatigue:
- Machine: Requires minimal human effort, just operation and setup.
- Human: Requires physical labor, leading to fatigue over time.

d) Quality & Consistency:
- Machine: Provides uniform coating.
- Manual: Dependent on painter's skill; inconsistencies can occur.

e) Cost & Maintenance:
- Machine: Higher upfront cost, requires maintenance, but saves labor costs long-term.
- Manual: No machine cost, but requires multiple laborers for large areas.

VII. CONCLUSIONS

Mobile Operated Wall Painting Machine proves to be an effective solution for automating painting tasks. It reduces labor costs, enhances precision, and speeds up the painting process. The system is easy to operate, cost-efficient, and scalable, making it a valuable innovation for the construction industry. With proper calibration and programming, the machine can be adapted for different wall textures, heights, and painting patterns.

VIII. ACKNOWLEDGMENT

I express my sincere thanks to Mr. S. J. Mulani whose supervision, inspiration and valuable discussion has helped us tremendously to complete our seminar work. His guidance proved to be the most valuable to overcome all the hurdles in the fulfillment of this project on “Mobile Operated Wall Painting Machine”. Last but not least, this acknowledgement would be incomplete without rendering my sincere gratitude to all those who have helped us in the completion of this seminar work.

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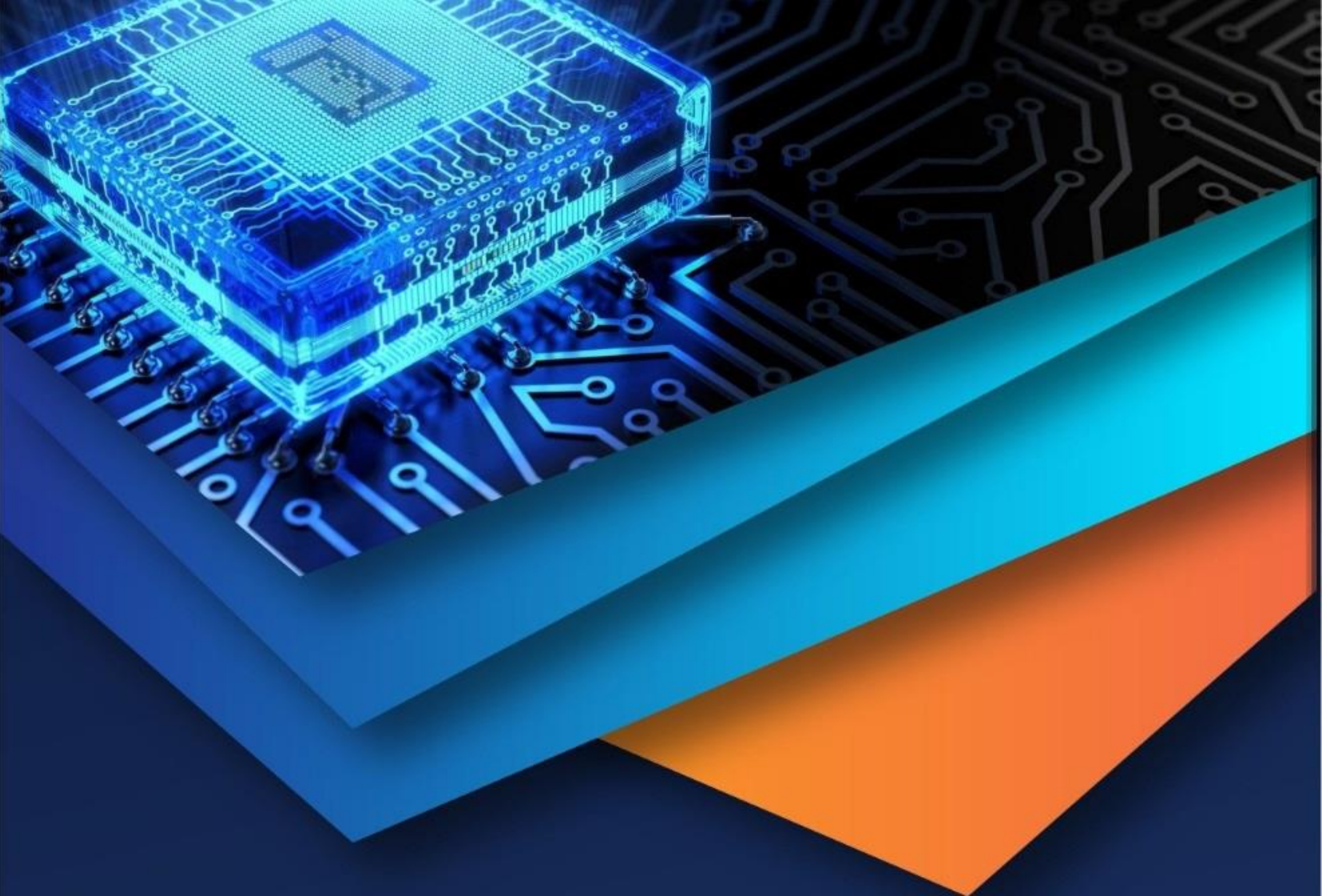

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