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# Design and Fabrication of Motorized Paint Spatula Scraper

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**Abstract:- In light of the increasing demand for construction globally, this study emphasizes the importance of painters' well-being in achieving structural aesthetics. The goal of the study is to enhance the ergonomic design of the widely used Paint Spatula Scraper, promoting comfort and productivity for painters. Currently, painters still rely on manually operated tools, which can cause strain on their hands and neck from constant use. Recognizing this challenge, we aim to improve the painter's experience by replacing the conventional paint spatula scraper with a state-of-the-art Slider Crank Mechanism integrated into a DC motor. The basic idea of this innovative design is to use a DC motor, which guarantees longevity, low maintenance, and efficiency. The paint spatula scraper's functionality is improved by the sophisticated mechanism known as the Slider Crank Mechanism, which is integrated with this motor and scraper is made of premium stainless steel, its durability and corrosion resistance are guaranteed. The blade, with dimensions of 200 mm in width and 0.5mm in thickness, guarantees excellent performance while maintaining a lightweight profile for ease of use. This cutting-edge instrument promises painters a future where their work becomes more enjoyable, sustainable.**

***Keywords:-*** *Paint Spatula Scraper, Ergonomic Design, Comfort and Productivity, Manual Tool Strain, Slider Crank Mechanism, DC Motor Integration, Longevity, Efficiency, Stainless Steel Scraper, Durability, Corrosion Resistance, Lightweight Design, Blade Dimensions, Painter's Experience, And Sustainable Tools.*

## I. INTRODUCTION

It is essential in construction to make sure that tools and equipment are safe and comfortable to use. As an example, consider the difficulty of removing paint with abrasive methods. Due to its physical demands and repetitive nature, this job may eventually cause discomfort and harm to its employees.Paint scraper is one example of a tool that can benefit substantially from ergonomic features that increase user comfort and safety. For example, including motorized movement and guaranteeing an even distribution of weight can lessen the pressure on the hands and arms of the user, facilitating prolonged tool use without fatigue or discomfort. This enhances the user experience overall and reduces the possibility of musculoskeletal problems and injuries brought on by extended usage of poorly made instruments.Paint spatula scraper (PSS) is one particular area where ergonomic innovation can have a big influence. Nowadays, hand tools are frequently used by painters, which can be uncomfortable or even painful to handle, especially after extended use.

The manual process may result in inconsistent results and require additional time and effort to achieve a satisfactory finish. Finally, manual paint removal from walls presents significant challenges for painters because of the physical strain it imposes on their hands, wrists, arms, and neck show in figure 1.

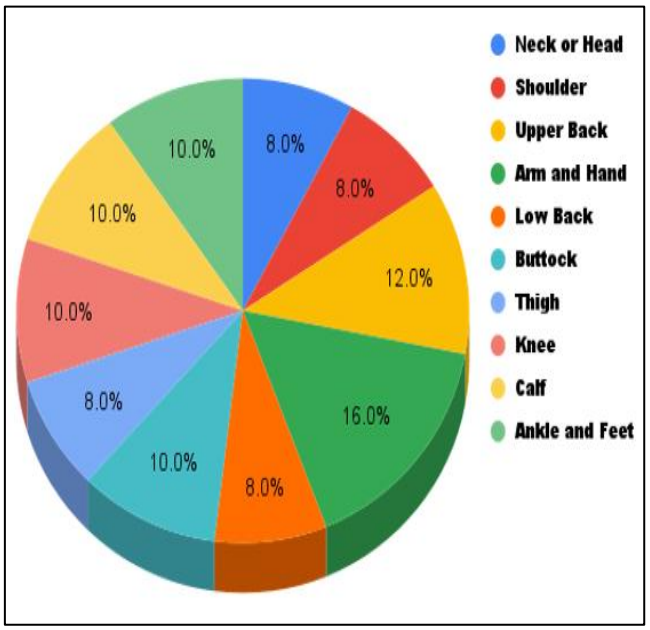


Fig 1: Strain Chart

Acknowledging this difficulty, our research attempts to enhance the painter's experience by presenting a novel solution that substitutes the conventional paint spatula scraper with a DC motor that incorporates a Slider Crank Mechanism. Utilizing a DC motor, which guarantees effectiveness, longevity, and less maintenance requirements, is the fundamental component of this inventive design.The paint spatula scraper's functionality is improved by the clever Slider Crank Mechanism, which is paired with this motor. The Slider Crank Mechanism offers accurate movement, leading to paint removal that is smoother and more effective. Furthermore, even after extended periods of usage, the ergonomic design lessens the strain on the painter's hands and arms, improving comfort.

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Our goal is to greatly enhance the painter's working environment by integrating these cutting-edge technology into the paint spatula scraper design. This will boost productivity and increase worker satisfaction overall.

## II. LITERATURE SURVEY

Jeremy Laurence Mendoza Banez, Jhonnel Ignacio Dela Cruz et al.(2019) conducted a study aimed at evaluating the level of discomfort experienced by construction workers when using the Paint Spatula Scraper (PSS). The construction sector has witnessed a surge in labor force due to increasing demands for housing and infrastructure prompted by population growth. Despite the vital role painters play in adding the finishing touches to constructions, little attention has been given to addressing the potential pain and hazards associated with their equipment. Through the use of the Body Discomfort Chart and Strain Index Chart, they identified heightened risks of discomfort among workers, which could potentially lead to work-related diseases such as musculoskeletal disorders (MSDs) and Repeated Task-Induced Cumulative Trauma Disorders (CTDs). In response to these findings, the researchers proposed an ergonomically redesigned paint spatula scraper aimed at mitigating the identified hazards. This study offers valuable insights for construction companies and related industries, underlining the importance of assessing and rethinking instruments like the PSS to safeguard both worker productivity and well-being in the long term.

Borstad and McClung's et al.(2019) has made an introduction of the hand-held hardness gauge marking a significant advancement in snow science instrumentation by repurposing a paint scraper blade to minimize costs. The integration of a digital push-pull gauge added precision to measurements, crucial for accurately assessing snow hardness and addressing long-standing issues in conventional testing methods like compression and densification. Its simplicity and repeatability offered a practical solution for tracking snow transitions and identifying relative hardness between different layers, emphasizing its potential to improve safety measures in snow-related activities and enhance our understanding of snow behavior. This study underscores the importance of innovation and practicality in developing tools for environmental research and hazard mitigation.

Oyawale and Otesile et al.(2021) addressed the issue of cobweb infestations in high-rise structures by designing a vacuum cobweb cleaner using fundamental manufacturing concepts. Their study utilized approaches such as cutting, joining, machining, and drilling to precisely select materials for vacuum cleaners, scrubbers, and floor polishers. While the resulting device functioned effectively, the authors acknowledged the need for improvement, particularly concerning suction for sticky webs. This study presents a practical solution to building maintenance challenges, potentially offering a safer and more efficient method for removing cobwebs from tall buildings. As an alternative to hazardous cleaning techniques involving scaffolds and long poles with wet cloths or foam rubber, Oyawale and Otesile's vacuum cobweb cleaner offers a promising avenue for addressing cobweb infestations.

Stevens et al. (2018, September 12) delved into the pivotal role of paint scrapers in achieving optimal results in paint preparation. While acknowledging the effectiveness of power washers and sanders for covering large areas, Stevens underscored the indispensability of paint scrapers for fine work. He discussed the versatility of putty knives and multitools for minor touch-ups, while highlighting the efficacy of double-edge scrapers with U-shaped blades for paint removal. Moreover, Stevens elucidated on the suitability of single-edge scrapers for handling complex profiles, emphasizing the importance of blade sharpness irrespective of its type. Beyond blade profiles, Stevens emphasized the significance of selecting the appropriate scraper based on task complexity and surface condition. Additionally, he stressed the importance of regular maintenance to prolong the lifespan of paint scrapers and ensure consistent excellence in all paint preparation endeavors.

Allsteel et al. (2006) presents a comprehensive reference guide on ergonomics and design, offering valuable insights into optimizing workspaces for enhanced comfort, productivity, and safety. The publication serves as a valuable resource for designers, architects, and professionals involved in creating ergonomic environments. By providing practical guidelines and best practices, Allsteel, Inc. contributes to the promotion of ergonomic principles in various industries and work settings. This reference guide underscores the importance of considering ergonomic factors in design decisions to create user-friendly and supportive spaces that prioritize human well-being.

Safety (2019, April 8) provided insight into Work-Related Musculoskeletal Disorders (WMSDs), shedding light on their prevalence and impact on individuals in various occupational settings. The article highlighted the importance of understanding and addressing WMSDs to promote workplace safety and employee well-being. By emphasizing the need for preventive measures and ergonomic interventions, Safety underscored the significance of proactive approaches in mitigating the risks associated with WMSDs. This literature review served as a valuable resource for professionals and organizations seeking to enhance their awareness and strategies for managing WMSDs effectively.

Johnson and White (2020) discussed the challenges clinicians faced in diagnosing and treating work-related musculoskeletal diseases (WRMSDs), exacerbated by ongoing debates over case definitions and terminology. Despite these challenges, recent advancements were made in understanding and managing WRMSDs. The authors noted that the term WRMSDs, previously used interchangeably with cumulative trauma disorders or repetitive strain injuries, held less etiological significance. However, untreated WRMSDs, affecting various body parts including the neck, lower limbs, back, and notably the upper limbs, could lead to significant expenses. Johnson and White emphasized the

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potential for reducing WRMSDs through appropriate assessment and intervention, considering their multifactorial nature involving physical, environmental, and organizational factors. They highlighted the pivotal role of physicians in advocating for improved knowledge, diagnosis, and therapeutic approaches for WRMSDs, as evidenced by recent research findings.

Boschman, Frings-Dresen, and Van der Molen (2014, December 29) conducted a follow-up study to investigate the utilization of ergonomic measures concerning musculoskeletal complaints among construction workers. Their research provided valuable insights into the effectiveness and adoption of ergonomic interventions aimed at addressing musculoskeletal issues in this occupational sector. By examining trends over a two-year period, the study contributed to our understanding of the long-term impact of ergonomic initiatives on the health and well-being of construction workers. Boschman, Frings-Dresen, and Van der Molen's work served as a significant resource for informing future strategies and interventions to improve ergonomics and reduce musculoskeletal complaints within the construction industry.

In 2012, the Occupational Safety and Health Administration reviewed Injury and Illness Prevention Programs for the United States Department of Labor. The document summarized key strategies for preventing workplace injuries and illnesses, emphasizing the importance of employers' proactive measures. It highlighted elements such as hazard identification, worker participation, and program evaluation. This review aimed to improve workplace safety and protect workers' health across various industries.

Craven, J. (2019, July 3) conducted a literature review for ThoughtCo, which was retrieved on August 4, 2019. In this review, Craven delved into a variety of topics, offering insightful analyses and summaries of existing literature. Covering a diverse range of subjects, the review provided readers with a wealth of knowledge and information. By synthesizing and presenting relevant research and ideas, Craven's work served as a valuable resource for individuals seeking to expand their understanding of various subjects. Whether exploring history, science, culture, or other disciplines, ThoughtCo's literature review facilitated learning and exploration, contributing to the dissemination of knowledge and fostering intellectual curiosity.

➢ *Summary of the Literature Review:*

- An evaluation of the Paint Spatula Scraper (PSS) discomfort experienced by construction workers highlighted the necessity for ergonomic redesigns to safeguard worker safety.
- In comparison to conventional approaches, a portable hardness tester for assessing snow penetration resistance was devised, providing a more affordable option with consistent measurements.
- The purpose of a vacuum cobweb cleaner is to remove cobweb infestations from high-rise buildings, providing a workable solution to common building maintenance issues.
- It highlighted how crucial paint scrapers are to paint preparation, with particular attention paid to blade profiles, sharpness, and choosing the right scraper for the job.
- Work-related musculoskeletal diseases (WRMSDs) present treatment challenges that underscore the significance of appropriate assessment and management to reduce risks and enhance therapy approaches.

## III. METHODOLOGY

Traditional method involved in paint scraper is shown in figure 2,

Fig 2: Manual Paint Removal

The figure 3 represents the flow chart of step by step procedures

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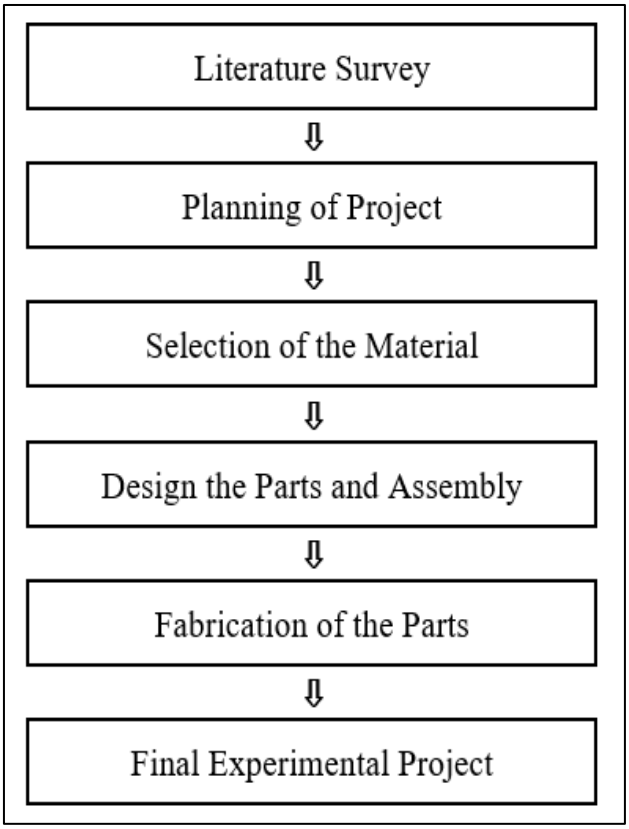

Fig 3: Flow Chart of Work Flow

*A. List of Components:*

➢ *The Parts Listed Below are Utilized in My Project*

- Mild Steel hollow Frame
- DC Motor
- Battery
- Gear

*B. Design Calculations:*

The parameters and specifications for various moving components and parts of the machine were first calculated for preparing an optimal design of the product.

*C. Dimension for Setup:*

- Mild Steel used:
- Height of the Setup=1600mm
- Thickness of the Frame=30mm

*D. Dimension Calculation for Disc:*

- Diameter of the Disc=130mm
- Offset hole =40mm(from center)

*E. Dimension Calculation for Spatula Scraper:*

- Width of the blade=250mm
- Height of the blade=100mm
- Stroke length=80mm
- It covers around,
  25*8=200 cm^2 area per stroke
  Operating Speed=60 rpm.
- It will cover 60*200=12000 cm^2 area per minute.
  =1.2 m^2/min
  =0.02 m^2/s

*F. Motor Power Calculation:*

➢ *Current and Voltage Required for the Motor is 10 Ampere and 12 Volts.*

Watt =Current*Voltage
W=10*12
W=120 watts.

➢ *The Electric Motor is Rated at 24 Watts and Running at 60 Revolutions Per Minute(r.p.m), and 746* ***watts =1 horsepower.***
120 watts=1/746*120
**P=0.160 horsepower**

➢ *If the Motor Runs 6 Hours Per Day the Power Consumption is,*
120*6=720 watt hour
**0.720 unit per day**

*G. Torque Produced:*

Power(P) required to drive the shaft is 120 watts and running with 60 rpm speed(N).

P=120W
N=60 rpm
**P=(2πNT)/60 Watt**
**T=(P*60)/(2πN) N.m**
T=(120*60)/(2*π*60)
T=19.09 N.m
**T=1909 N.cm**

*H. Force Diagram:*

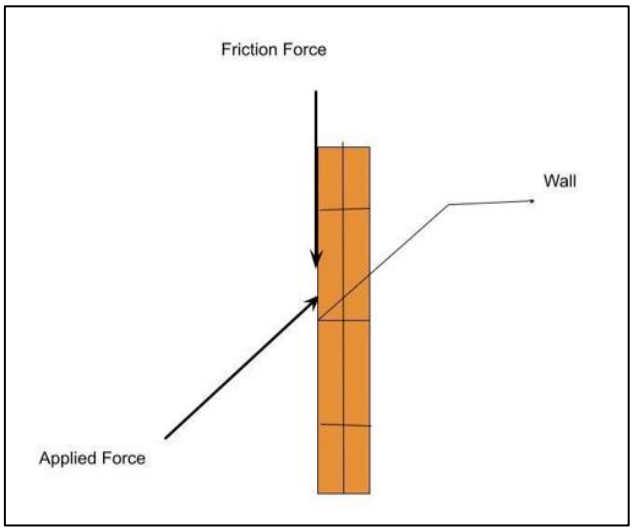

Fig 4: Force Diagram

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*I. Maximum Force Required to Scrap:*

The forces acting on the wall in x and y directions shown in figure. When the Scraper acts on the wall at an angle of 45°.

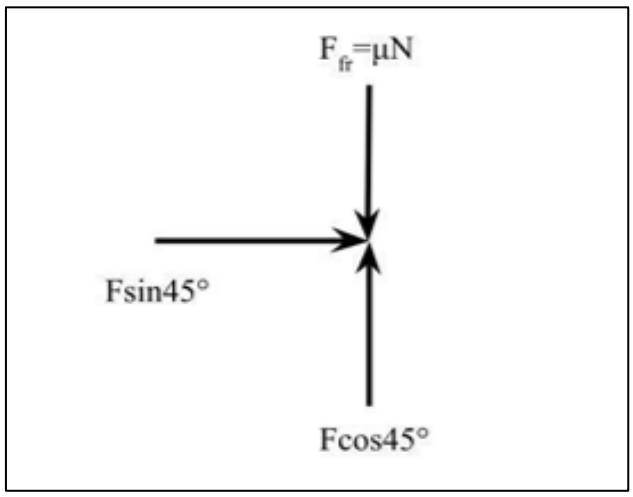


Fig 5: Maximum Force Required to Scrap

From the x-direction,

$\sum F_x = F*\sin 45°$

From the y-direction,

$\sum F_y = F*\cos 45° - \mu N$

Where,
F = Maximum force required to Scrap the paint from wall(N).
N=Normal force acting on the wall(N).
μ= Friction coefficient.

*J. Conceptual 3D Model:*

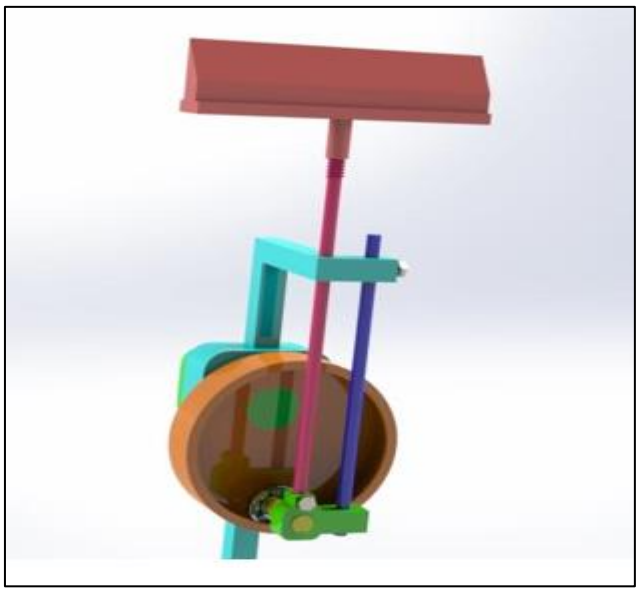

Fig 6: Front View of the Paint Scraper

Fig 7: Side View of the Paint Scraper

*K. Working Principle:*

The project operates on the principle of utilizing a motor-driven system to scrape paint or similar substances from a surface. A motor, powered by a battery or external source, drives a gear mechanism. This gear system, in turn, imparts rotational motion to a slider crank mechanism. The crank, attached to a scraper, converts this rotational motion into reciprocating motion. As the motor rotates, the scraper moves up and down, effectively scraping the targeted surface. This coordinated action between the motor, gear, crank, and scraper enables efficient removal of unwanted material from surfaces, contributing to the project's functionality.

*L. Fabrication Model:*

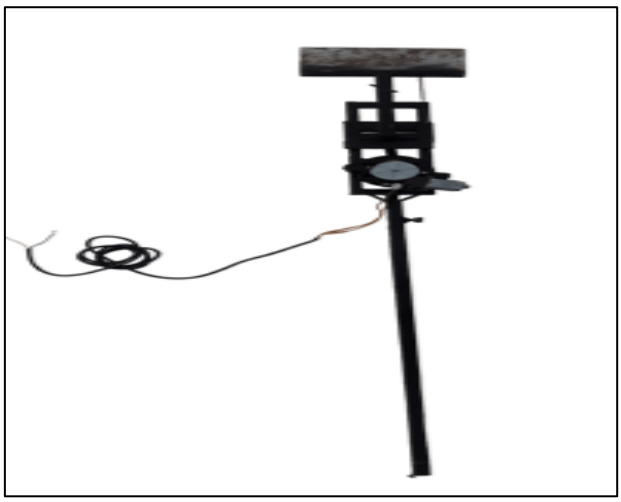

Fig 8: Full View

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Fig 9: Back Side View

## IV. CONCLUSION

This involved evaluating alternative options, analyzing their properties, and justifying our choices based on their compatibility with our project objectives.The design phase was characterized by iterative optimization, with continuous refinement based on feedback from stakeholders and testing results. We prioritized ergonomics, functionality, and aesthetics, ensuring that the final product not only performs well but also enhances the user experience.In the fabrication process, we employed a combination of traditional techniques and innovative approaches, maintaining a focus on quality assurance and adherence to industry standards. Rigorous testing protocols were implemented to validate the performance and safety of the paint scraper, ensuring its reliability in real-world applications.Looking ahead, we are committed to continuous improvement, leveraging user feedback and emerging technologies to enhance the performance and functionality of the paint scraper. Our project serves as a testament to the power of thoughtful design, meticulous fabrication, and a dedication to excellence.

As we reflect on our achievements and lessons learned, we are proud of the robust and user-friendly paint scraper that we have created. With a solid foundation laid and a clear roadmap for future development, we are excited to see how our project will continue to evolve and make a positive impact in its intended applications.

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