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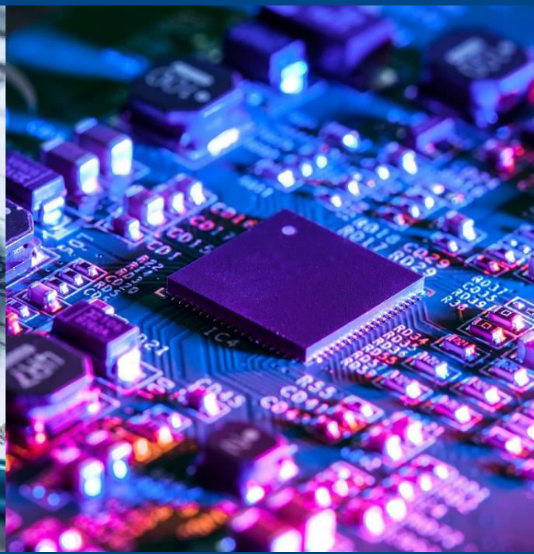

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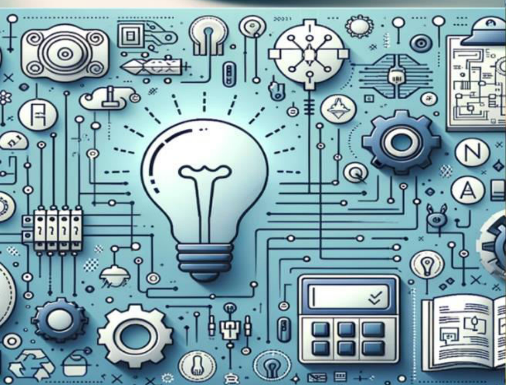

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International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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# Design & Development of Motorized 4 Way Hacksaw

**Ashish. Shankar Sarabi, Chaitanya Yashwant Patil, Omkar Dadasaheb Londhe, Suresh Chenaram Choudhary**

Diploma Students, Department of Mechanical Engineering, Jayawantrao Sawant Polytechnic, Pune, India

**Prof. V.B. Ghule**

Lecturer, Department of Mechanical Engineering, Jayawantrao Sawant Polytechnic, Pune, India

**ABSTRACT**: The project titled "Design and Development of Motorized Four Way Hacksaw Mechanism" aims to enhance the productivity and efficiency of conventional metal cutting processes by integrating a multi-directional cutting system powered by a single motor. Traditional hacksaw machines are typically limited to single-direction cutting, resulting in longer operation times and increased manual intervention. This project introduces an innovative four-way hacksaw setup, where four blades operate simultaneously in perpendicular directions, thereby enabling the cutting of multiple workpieces at once. The mechanism is driven by a single motor through an eccentric cam and crank arrangement, ensuring uniform motion transmission to all hacksaw frames. This design significantly reduces operational time and labour costs, making it suitable for medium-scale production environments. The project also focuses on optimizing the design for ease of maintenance, compactness, and energy efficiency. Overall, this motorized four-way hacksaw mechanism presents a practical solution to meet the growing demands of faster and more efficient material cutting in workshops and manufacturing units.

**KEYWORDS:** Analysis, Double slider crank, Four hacksaws, Mass production, Safe operation.

## I. INTRODUCTION

The automated nature of the motorized 4-way hacksaw significantly accelerates the cutting process. By reducing the reliance on manual effort, the machine not only enhances productivity but also ensures precision and accuracy in each cut. This is particularly important in industries where the quality of the cut can impact the overall integrity and performance of the final product. The machine's design incorporates adjustable settings that allow operators to control the speed, direction, and depth of the cut, providing greater flexibility and control over the cutting process. The automated nature of the motorized 4-way hacksaw significantly accelerates the cutting process. By reducing the reliance on manual effort, the machine not only enhances productivity but also ensures precision and accuracy in each cut. This is particularly important in industries where the quality of the cut can impact the overall integrity and performance of the final product. The machine's design incorporates adjustable settings that allow operators to control the speed, direction, and depth of the cut, providing greater flexibility and control over the cutting process. The development of the motorized 4-way hacksaw project reflects a significant advancement in cutting technology. It showcases the integration of traditional engineering principles with modern automation to create a tool that not only meets but exceeds the demands of contemporary manufacturing and workshop environments. By embracing automation, this machine represents a step towards more efficient, precise, and safe cutting processes, ultimately contributing to the advancement of industrial and engineering practices.

Firstly, the motorized 4-way hacksaw enhances the efficiency of cutting operations. Traditional manual hacksaws are labour-intensive and time-consuming, often requiring significant physical effort and time to complete cuts, especially in hard materials. By integrating a motorized mechanism, this project dramatically reduces the manual labour involved, allowing for faster cutting processes and higher productivity. The 4 way feature further adds to this efficiency by enabling cuts in multiple directions, minimizing the need to reposition the material and thereby saving valuable time.

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## II. WORKING PRINCIPLE

This Project works on Mainly 'Scotch Yoke Mechanism'.

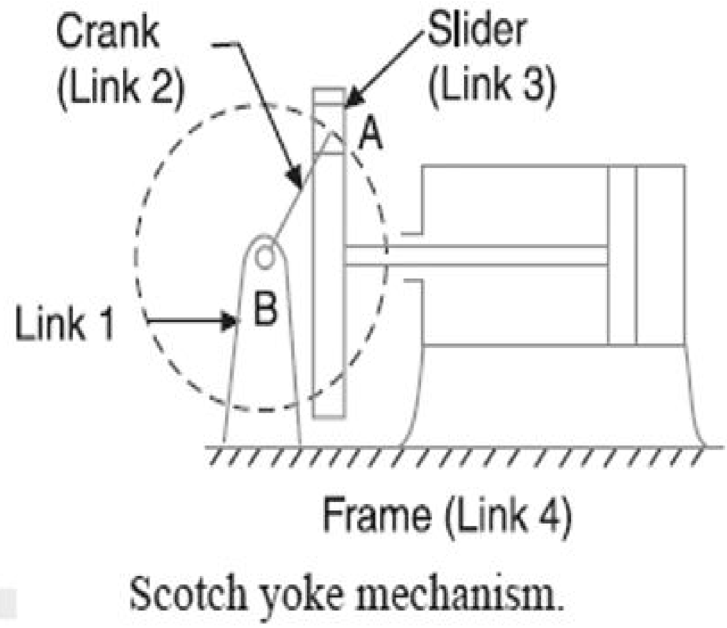


**Fig. 1. Scotch Yoke Mechanism**

The Scotch Yoke mechanism is a fascinating and efficient method used to convert rotary motion into linear motion, or vice versa. It is a mechanical arrangement in which a rotating input, such as a crank or cam, drives a yoke that slides back and forth in a straight line. The yoke typically has a slot or groove that engages with a pin or slider attached to the rotating component. As the crank rotates, the pin follows the path of the groove, causing the yoke to move in a reciprocating linear motion. This mechanism is widely used in various applications, including internal combustion engines, compressors, and pumps, due to its simplicity and ability to produce smooth linear motion with minimal friction.

To visualize this, imagine the crank rotating in a clockwise direction. As the crank rotates, the slider moves in a circular path, reaching the topmost position of its motion. At this point, the yoke is at one extreme of its linear motion. As the crank continues to rotate, the slider moves downward along the slot, causing the yoke to move towards the opposite extreme of its linear motion. This continuous rotation of the crank results in a reciprocating linear motion of the yoke.

**Crank**: The crank is a rotating component that is typically driven by an electric motor or another source of rotational motion. The crank has a pin or slider attached to it, which moves in a circular path as the crank rotates.

**Slider or Pin**: The slider or pin is connected to the crank and follows the circular motion dictated by the crank's rotation. This slider or pin is engaged with the slot or groove in the yoke.

**Yoke**: The yoke is a rectangular or cylindrical component with a slot or groove that accommodates the slider or pin. As the crank rotates, the slider moves within the slot, causing the yoke to move linearly back and forth. When the crank rotates, it imparts a circular motion to the slider or pin. This circular motion is constrained by the slot in the yoke, forcing the slider to follow the path defined by the slot. As a result, the yoke is pushed back and forth in a linear motion.

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## III. COMPONENTS REQUIRED

### 1. Machine Frame

**Fig. 2. Machine Frame**

The machine frame crafted from mild steel square pipes serves as the backbone of your motorized 4-way hacksaw project. Mild steel, known for its robustness and excellent tensile strength, ensures the frame is sturdy enough to withstand the dynamic stresses and vibrations generated during operation.

### 2. Connecting Rods

**Fig. 3. Connecting Rods**

The connecting rods, fabricated from durable mild steel bars, play a pivotal role in ensuring the efficient functioning of your motorized 4-way hacksaw. Mild steel, with its exceptional balance of strength and ductility, is an ideal choice for this application. It provides the rods with the necessary resilience to endure repetitive cyclic loads and mechanical stresses without succumbing to fatigue or deformation over time.

### 3. Electric Motor

**Fig. 4. Electric Motor**

The 12-volt, 100 RPM geared DC motor is a powerhouse of precision and efficiency, perfectly suited to drive the mechanisms of your motorized 4-way hacksaw. Its 12-volt operation ensures compatibility with standard power supplies or batteries, making it a practical and versatile choice for your project. With a rotational speed of 100 revolutions per minute, this motor strikes an excellent balance between speed and torque, providing the controlled yet powerful motion necessary for accurate cutting operations.

**4. Battery**


**Fig. 5. Battery**

The 12-volt, 7Ah lead-acid battery is the lifeblood of your motorized 4-way hacksaw, providing a reliable and steady source of power to drive the entire system. With a capacity of 7 ampere-hours, this battery is designed to deliver consistent energy over an extended period, ensuring uninterrupted operation during demanding cutting tasks. Its 12 volt output aligns seamlessly with the requirements of the DC motor and other electrical components in your project, creating a harmonious power supply system.

**5. Hacksaw Blades**

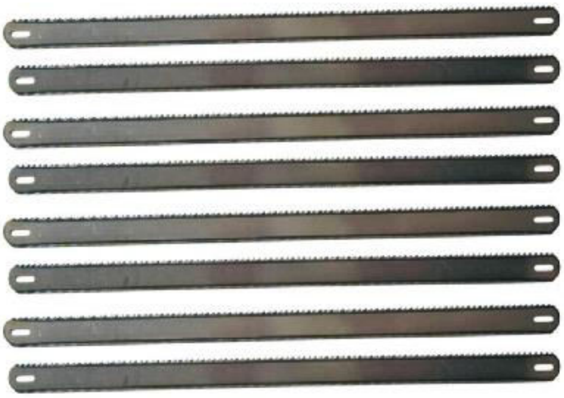

**Fig. 6. Hacksaw Blades**

Bimetallic hacksaw blades are engineered for superior performance and durability. They are crafted by fusing two different metals—a flexible, shatter-resistant steel for the blade's body and a harder, wear-resistant steel for the cutting teeth. This combination ensures a blade that is both tough and long-lasting, capable of cutting through a variety of materials with precision while resisting breakage under stress.

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## IV. RESULT AND DISCUSSION

**Fig. 7. Final Output of the project**

After the assembly of the motorized 4-way hacksaw, the final output presents a functional and efficient system capable of performing cutting tasks with enhanced productivity and reduced manual effort. The integration of the mechanical, electrical, and power components demonstrates the successful realization of the design objectives. The hacksaw operates smoothly, powered by the 12V, 100 RPM gear DC motor, which provides sufficient torque to drive the blades effectively. The scotch yoke mechanism ensures a precise and synchronized linear motion, enabling all four cutting blades to work simultaneously. This feature significantly reduces the time required to process materials compared to conventional single-blade hacksaws. The lead-acid battery supplies stable and reliable power to the motor, ensuring uninterrupted operation for extended durations. During testing, the device performed exceptionally well on materials like wood, plastic, and soft metals, achieving clean and precise cuts. The system's ability to handle multiple cutting directions at once proved to be its standout feature, demonstrating its suitability for applications in workshops or small-scale industries where time efficiency is crucial. Additionally, the design's portability and compactness enhance its usability in varied environments.

## V. CONCLUSION

The final result showcases a system that not only meets its objectives but also highlights the ingenuity and precision involved in its design. By reducing manual effort and introducing simultaneous multi-directional cutting, the hacksaw achieves higher efficiency and precision compared to conventional methods. The compact and portable nature of the system makes it versatile for workshops, small industries, and various cutting tasks. Although the project faced challenges during development, such as blade alignment and power optimization, these were addressed effectively, improving the final product. The completion of the project also opened new possibilities for future enhancements, such as automating operations, integrating renewable energy, or upgrading to more energy efficient components. In its current form, the motorized 4-way hacksaw is a reliable and cost-effective solution, blending practicality with innovation. Its success is a testament to the collaborative effort and engineering expertise applied, making it a valuable addition to modern cutting tools. This project not only achieves its immediate goals but also lays the foundation for further advancements in similar mechanical systems.

## VI. FUTURE SCOPE

The motorized 4-way hacksaw has a lot of potential for future improvements and applications, making it a versatile and adaptable project. One of the key areas for future development is upgrading its power source. While the current design uses a lead-acid battery, this could be replaced with lighter and more efficient options like lithium-ion batteries. These modern batteries would not only reduce the weight of the system but also provide longer runtime and better energy efficiency, making the hacksaw more practical and portable. Another exciting possibility is the integration of renewable energy sources. For example, solar panels could be used to charge the battery, making the device more sustainable and environmentally friendly. This would be especially useful in rural or remote areas where access to electricity might be limited, allowing the hacksaw to operate without relying on traditional power sources. Automation is another promising direction for this project. By adding sensors or microcontrollers, the hacksaw could be enhanced to make smart decisions, such as adjusting the blade speed or pressure based on the material being cut. This would not only improve

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precision but also expand its ability to handle a wider variety of tasks. Automation could also make the device safer to use, as features like automatic shut-off or overload protection could be introduced.

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