

Fabrication and Assembly of a Multi Purpose Cutter

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Abstract – The increasing demand for cutting tools in various industries has highlighted the need for versatile and efficient solutions. This study focuses on the design, fabrication, and assembly of a Multi-Purpose Cutter (MPC) to address this demand. The MPC integrates four cutting edges in one tool, providing flexibility for different applications. The fabrication process involves careful material selection and precision machining to ensure durability and optimal performance. Testing results show that the MPC can efficiently handle multiple materials, demonstrating its potential for enhancing productivity in industrial cutting tasks. The results suggest that the MPC can serve as an innovative solution to improve cutting efficiency across various sectors

Keywords – Cutting Tools, Industrial Cutting Solutions, Tool Fabrication, Precision Machining, Material Selection, Cutting Efficiency, Productivity Enhancement.

I. INTRODUCTION

The increasing demand for cutting tools in various industries has highlighted the need for versatile and efficient solutions. In industrial applications, there is a growing demand for cutting tools that offer versatility, efficiency, and precision. Traditional tools like jig saws, scroll saws, router tables, and table saws are effective for specific tasks but often require frequent tool changes and setup adjustments, leading to inefficiencies. The Multi-Purpose Cutter (MPC) addresses this challenge by integrating the capabilities of these four essential tools into a single system. This combines the jig saw for curved cuts, scroll saw for intricate detailing, router table for edge shaping, and table saw for straight cuts, providing an all-in-one solution.

By combining these tools, it reduces downtime and enhances productivity across various cutting tasks. This study focuses on the design, fabrication, and assembly of the MPC, with an emphasis on optimizing material selection, precision, and durability. This aims to improve cutting efficiency in industries that require diverse cutting capabilities, providing a more streamlined and cost-effective solution.

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II. METHODOLOGY

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The MPC integrates four cutting edges in one tool, providing flexibility for different applications. It is designed to cut wood and soft-type metals up to a certain hardness level, making it suitable for a range of industrial and fabrication needs. The fabrication process involves careful material selection and precision machining to ensure durability and optimal performance. Testing results show that the MPC can efficiently handle multiple materials, demonstrating its potential for enhancing productivity in industrial cutting tasks. The results suggest that the MPC can serve as an innovative solution to improve cutting efficiency across various sectors.

III. DESIGN & CONCEPTUALIZATION

1. Design Process and Software Utilization

The initial design concept was developed using Fusion 360, a comprehensive 3D CAD software that enabled detailed modelling, simulation, and visualization. Fusion 360 facilitated the creation of a virtual prototype, allowing for the evaluation of different configurations and ensuring the seamless integration of all components into a single unit. This approach helped optimize the design for functionality and manufacturability, ensuring that the MPC would be practical to fabricate and assemble.

2. Key Design Considerations

The jig saw and scroll saw shared a common cutting base, which allowed the user to easily switch between intricate cuts and straight cuts without needing to change tool setups. The router table was incorporated with an adjustable height mechanism to facilitate precise edge shaping, while the table saw was integrated for larger, straight cuts with high accuracy. Additionally, the design prioritized user-friendliness, incorporating ergonomic controls and a simple switching mechanism between tools to enhance usability.

3. Optimization and Challenges

The design process focused on optimizing space to integrate the four tools while maintaining a compact and efficient layout. Key challenges addressed included ensuring sufficient clearance for each tool's operation, enhancing the stability of the system, and addressing safety features to minimize potential risks during operation. Fusion 360 allowed for the testing and refinement of these aspects in the digital prototype, ensuring that these concerns were tackled early in the design phase.

4. Final Design and Outcome

The final design of the MPC integrates all four tools—jig saw, scroll saw, router table, and table saw—into a cohesive and versatile system that maximizes cutting efficiency. By combining these functions, this eliminates the need for multiple machines, reduces downtime, and streamlines the workflow. The design also ensures ease of operation and safety, providing a comprehensive solution for industrial applications requiring diverse cutting tasks.

IV. FABRICATION PROCESS

1. Material Selection

The frame of the MPC was built using wood for its ease of machining, stability, and cost-effectiveness. A high-quality hardwood was chosen to ensure strength and rigidity, providing a solid foundation to mount all the tools. The frame was designed to be stable, reducing vibrations during cutting and ensuring smooth, precise operations.

2. Tool Procurement and Integration

Instead of manufacturing the individual tools, we purchased reliable pre-built components for the jig saw, scroll saw, router table, and table saw. These tools were selected based on their performance, quality, and compatibility with the overall design of the MPC.

- **Mounting System for Dynamic Tools:**

The table saw and router table were mounted on adjustable systems with sliders and screws. This allowed these tools to be moved vertically. When the table saw was in use, the router table would slide down, and vice versa. This system allowed only one tool to be operational at a time, optimizing space and making it easy to switch between cutting tasks.

- **Fixed Tools:**

The jig saw and scroll saw were securely fixed to the frame since they did not require vertical adjustments. These tools are designed to operate without

needing movement for different cutting tasks, so they were kept stationary on the base. Blade changes are the primary adjustment for these tools, ensuring that they remain functional while other tools are being used.

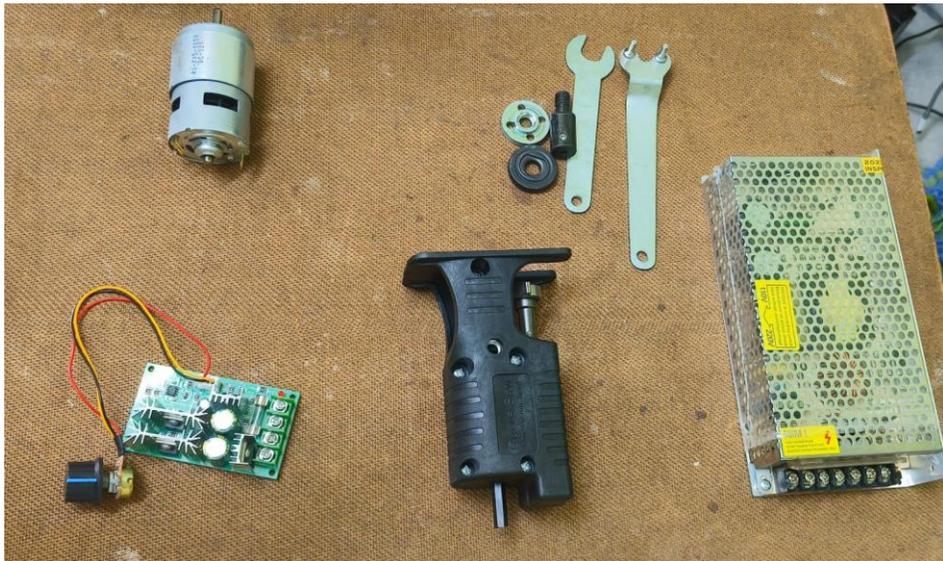


Fig.1 Tools

3. Electrical System and Controls

The MPC was designed to have a 12V DC motor to drive the cutting mechanisms. This motor was selected for its ability to provide sufficient torque for each tool while ensuring energy efficiency. Additionally, an SMPS (Switched-Mode Power Supply) was incorporated to provide stable, reliable power to the motor and other electrical components, ensuring smooth operation with minimal heat generation.

4. Assembly and Testing

Once all the purchased tools were received, the jig saw, scroll saw, router table, and table saw were carefully integrated into the wooden frame. Each tool was mounted securely, with special attention given to the sliding and locking mechanism of the table saw and router table. The system was then tested to ensure that each tool operated as intended and that the sliders and screws allowed smooth vertical adjustment for the table saw and router table.

• Quality Control and Performance Testing:

After assembly, the MPC underwent testing to ensure proper functionality. The table saw and router table were tested for smooth vertical movement and precise positioning, while the jig saw and scroll saw were tested for stability during operation. The system was also checked with various materials to ensure that it could handle a wide range of cutting tasks efficiently.

5. Finishing and Final Adjustments

The wooden frame was treated with protective finishes to prevent damage from moisture and wear over time. Surface treatments were applied to enhance the

appearance and durability of the frame. After finishing, the system was adjusted and calibrated for optimal cutting accuracy, ensuring all tools were working effectively and safely.

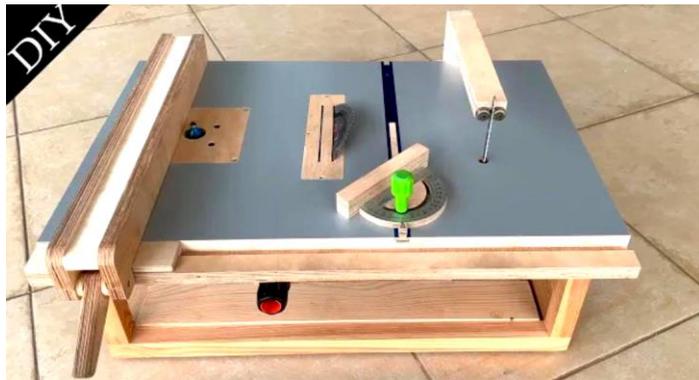


Fig. 2. Multi Purpose Cutting Machine.

V. ASSEMBLY OF THE MPC

Step-by-Step Assembly Process

1. Base Frame Assembly:

The first step in the assembly process was constructing the base frame using high-quality wood. The frame was carefully measured and cut to ensure it provided a stable and rigid structure capable of supporting the weight and vibrations from the integrated tools. All joints were reinforced for added strength and stability

2. Tool Mounting:

After constructing the base frame, the next step was mounting the purchased tools jig saw, scroll saw, router table, and table saw. The jig saw and scroll saw were fixed securely in place, while the table saw and router table were mounted on adjustable sliding systems. The sliding systems used sliders and screws to allow smooth vertical adjustments between the tools.

3. Electrical Component Integration:

The next phase involved installing the 12V DC motor and the SMPS (Switched-Mode Power Supply). The motor was connected to each tool, and the SMPS ensured stable power distribution to the motor and other components. The wiring was carefully routed to avoid interference with the moving parts and to ensure that the electrical components were safely secured.

Challenges Faced During Assembly

Several challenges were encountered during the assembly process, particularly in the integration of the sliding mechanism for the table saw and router table. Ensuring smooth movement while maintaining the stability and rigidity of the tools required several iterations of adjustments to the sliders and locking screws. Additionally, wiring the 12V DC motor and SMPS without causing interference with the moving parts of the system presented another challenge. This required careful planning of cable routing and securing of all electrical components

Another challenge was ensuring the alignment of the tools within the frame, especially considering that the table saw and router table had to be adjustable and move vertically while maintaining a secure and precise position during operation. It took time to fine-tune the locking mechanism to guarantee the tools remained stable when in use.

VI. CONCLUSION

The development of the Multi Purpose Cutter successfully integrated four different cutting tools—jig saw, scroll saw, router table, and table saw—into a single, versatile system, demonstrating significant potential for improving productivity in industrial cutting tasks. Through careful design and fabrication, this offers flexibility, efficiency, and space-saving capabilities, allowing operators to seamlessly switch between tools as needed. The integration of a sliding mechanism for the table saw and router table ensured smooth transitions between operations, while the jig saw and scroll saw remained fixed for stability and ease of use.

The system demonstrated excellent performance across various materials, providing precise cuts and reliable results. The 12V DC motor and SMPS effectively powered the system, ensuring consistent operation without overheating. Although the MPC faced minor challenges related to the vertical adjustment mechanism and tool transitions, these issues were manageable and could be resolved with future design improvements.

Overall, this represents an innovative approach to multi-tool systems, enhancing cutting efficiency and offering valuable solutions for industries that require high versatility in their cutting operations. With further refinements, the MPC can be expanded to handle a broader range of materials and become an even more effective tool for various industrial applications.

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