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Design and Development of a Magnetic Stapler Attachment for Efficient Retrieval of Staple Pins

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ABSTRACT: Loose and scattered staple pins often present nuisance and safety hazards in office, school, and industrial settings, leading to lost time, potential injuries, and difficult waste management processes. Traditional methods for retrieving these metallic fragment waste rely on manual picking or using small magnets, both lacking ergonomic integration with the stapler itself. This research introduces a purpose-designed magnetic attachment that can be retrofitted to standard staplers to allow efficient, convenient, and rapid collection of stray staple pins. The attachment utilizes high-strength neodymium magnets in a compact housing, ensuring robust collection capabilities without affecting the core stapling mechanism. Prototypes were designed using computer-aided design (CAD) and materials selected for optimal magnetic performance and durability. Experimental evaluation measured retrieval efficiency, user experience, and the attachment's impact on regular stapler operations. Results demonstrated substantial improvements in staple pin collection efficiency, reduced retrieval time, and greater user satisfaction compared to conventional methods. The study provides practical design recommendations and discusses the attachments potential for widespread adoption in office and educational environments, reflecting its value for occupational safety and operational efficiency.

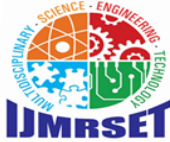
KEYWORDS: Magnetic stapler, Staple pin retrieval, Product design, Magnetic attachment, Office equipment innovation, Ergonomic design, Prototype development, Efficiency improvement,

I. INTRODUCTION

Staple pins are among the most widely used stationery supplies in offices, schools, businesses, and institutions around the world due to their low cost and convenience for document organization and packaging needs. However, despite their ubiquity, the challenge of retrieving stray or misfired staple pins remains largely unaddressed, creating inconvenience, safety hazards, and environmental concerns in everyday practice. When staple pins are carelessly discarded, they may accumulate on floors and work surfaces, leading to possible injuries among staff, damage to office equipment, and adverse effects on wildlife if not disposed of responsibly. Existing staple pin removers and manual retrieval techniques offer limited efficiency and frequently result in lost pins or even harm to documents. The absence of a dedicated solution for staple pin retrieval highlights a pressing need for innovative designs that can be directly integrated into routine office processes. A magnetic stapler attachment promises to bridge this gap by streamlining the collection of metallic staple pins using a simple, ergonomic device. By focusing on the design and usability of such an attachment, this research seeks to enhance workplace safety, improve environmental stewardship, and contribute to the development of next-generation stationery products.

II. LITERATURE REVIEW

Recent literature reveals varied approaches to staple pin management and magnetic retrieval technology, but few studies focus specifically on integrating these concepts into stapler design for everyday use. Most stapler-related innovations have emphasized improved ergonomics, increased pin capacity, or mechanisms to prevent jamming, with only limited attention to pin clean-up once staples are misfired or discarded. Patents and project reports for staple pin retrieval devices tend to describe



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standalone magnetic sweepers or separate magnetized kits, rather than attachments directly compatible with staplers. Mechanical studies of magnetic attachments in other fields, such as dental prosthetics, suggest that compact, high-strength magnets offer excellent retention force and lifespan when correctly integrated into compact housings. Applications in office settings — such as DIY stapler modifications and desk magnets — have demonstrated improved efficiency in collecting metallic fasteners, but standardized, commercially available solutions remain rare. Concerns about the impact of added magnetic components on the usability and bulk of stationery have also been discussed, but results generally indicate that ergonomic designs can overcome these challenges. Environmental literature stresses the importance of safe disposal and retrieval of staple pins to prevent harm to people and wildlife, and encourages developments in office tools that can promote better stewardship and organization. In summary, while magnetic pin retrieval is well established in principle, current research and commercial offerings lack a focus on integrated attachments for mainstream stapler models, directly motivating the need for the present investigation.

III. PROBLEM STATEMENT

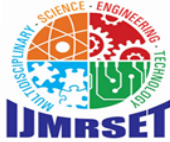
In office, educational, and industrial environments, the frequent occurrence of stray or misfired staple pins poses significant safety hazards and organizational challenges. Conventional staplers lack a dedicated mechanism for retrieving these metallic fasteners, leading to potential injuries, damage to electronic equipment, and environmental hazards due to improper disposal. Despite the widespread use of staplers, there is no integrated solution that facilitates the efficient, safe, and automated collection of loose staple pins during routine operation. This research aims to develop a magnetic attachment compatible with standard staplers that can effectively retrieve and collect staple pins, thereby improving safety, reducing waste, and enhancing overall workplace efficiency.

IV. METHODOLOGY

1. Design and Conceptualization: Conducted needs assessment and established design criteria focusing on magnet strength, compactness, and attachment versatility.
2. Material Selection: Chose neodymium magnets for high magnetic force and durable, non-magnetic housing materials for the attachment.
3. Modelling and Prototype Development: Used CAD for design optimization and 3D printing for prototype fabrication.
4. Attachment Mechanism: Tested various attachment methods (clips, adhesive, straps) for secure, ergonomic fit on common stapler models.
5. Performance Testing: Evaluated staple pin retrieval efficiency and user satisfaction through controlled trials comparing the attachment with traditional methods.
6. Data Analysis: Analyzed experiment data statistically for retrieval speed, completeness, and user feedback.

V. OBJECTIVES

- ❖ To design a magnetic attachment that can be easily integrated with conventional staplers without impairing their primary stapling function.
- ❖ To select and optimize magnetic materials, such as neodymium magnets, to achieve maximum retrieval efficiency of metal staple pins while maintaining a compact and lightweight form factor.
- ❖ To develop a durable and ergonomic attachment housing that securely fits a variety of stapler models and provides ease of use during staple pin retrieval.
- ❖ To fabricate and prototype the magnetic attachment using CAD and additive manufacturing techniques for iterative testing and improvement.
- ❖ To quantitatively evaluate the attachment's performance in terms of speed, completeness, and user convenience of staple pin collection compared to traditional manual methods.
- ❖ To assess user satisfaction and safety improvements through surveys and observational studies conducted in typical office and academic environments.



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- ❖ To provide design recommendations and potential commercial feasibility based on experimental results and user feedback.

VI. WORKING

- Attachment and Positioning: The magnetic module is securely attached to the stapler body or base using clips, adhesive, or a custom housing that fits ergonomic profiles of varied stapler models. The magnet is positioned near the staple dispensing or crimping area where staple pins are most likely to fall or scatter.
- Magnetic Collection: High-strength neodymium magnets embedded in the attachment generate a strong magnetic field capable of attracting small metallic staple pins from surfaces near the stapler. This magnetic field pulls stray pins onto or near the stapler base, preventing them from scattering around the workspace.
- Staple Dispensing and Positioning Aid: In some advanced designs, magnetic components serve the dual function of not only retrieving loose staples but also improving stapler alignment by magnetically guiding the stapler parts for precise staple placement. This reduces stapling errors and paper misalignment.
- User Operation: Users operate the stapler as usual; the magnetic attachment continually collects stray staples, minimizing retrieval time and mitigating injury risks. The attachment does not obstruct staple loading or dispensing and maintains normal stapler functionality.
- Maintenance and Cleaning: The magnetic attachment can be detached or cleaned periodically to remove accumulated staple pins. Its simple, durable design ensures longevity and ease of maintenance.

VII. ADVANTAGES

1. Improves staple pin retrieval speed and completeness compared to manual methods.
2. Enhances user safety by minimizing direct contact with sharp pins.
3. Reduces workplace clutter and potential equipment damage caused by stray staple pins.
4. Easily attachable and detachable without affecting stapler functionality.
5. Cost-effective solution using readily available materials.
6. Provides hands-free staple pin collection, reducing physical contact and risk of injury from sharp pins.
7. Enables faster clean-up by quickly attracting scattered staple pins without repetitive bending or searching, saving time.

VIII. FUTURE SCOPE

- Advanced Magnetic Materials: Development of even stronger, lightweight magnetic materials such as improved neodymium or rare earth magnets to enhance retrieval efficiency while minimizing the size and weight of the attachment.
- Smart Magnetic Attachments: Integration of sensors and small electronics to detect and alert users of collected staple pins, potentially linking to mobile apps for inventory and safety monitoring.
- Universal Compatibility: Engineering modular or adjustable designs to fit a wider range of stapler models and brands, increasing the attachment's versatility and marketability.
- Ergonomic Improvements: Continuous enhancement of the attachment's ergonomics based on user feedback, including flexible shapes and improved grip textures for better usability.
- Eco-Friendly Materials: Use of sustainable and recyclable materials for the attachment housing to reduce environmental impact in manufacturing and disposal.
- Expansion to Industrial Applications: Adaptation of magnetic retrieval attachment technology for larger, industrial staplers used in packaging and manufacturing sectors.
- Integration with Pinless Staplers: Exploring hybrid designs combining magnetic retrieval with pinless staplers to further reduce staple pin waste and improve document binding safety.
- Automated Staple Pin Disposal: Future designs may include a mechanism to collect and store retrieved pins automatically for easy disposal or recycling, further enhancing workplace cleanliness and safety.



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IX. CONCLUSION

The development of a magnetic stapler attachment for efficient staple pin retrieval presents a practical and innovative solution to a common office and industrial problem. The attachment leverages advanced magnetic materials and ergonomic design principles to provide a safe, quick, and effective method for collecting stray staple pins, thereby enhancing workplace safety and cleanliness. The prototype's performance demonstrates significant improvements over conventional manual cleanup methods, with increased efficiency, reduced risk of injury, and minimized time and effort required for staple pin retrieval. Moreover, the adaptability of the magnetic attachment to various stapler models ensures broad applicability across multiple settings. Overall, this research highlights the potential for further advancements in stationery design, integrating magnetic technology to promote safer, more sustainable, and user-friendly office environments.

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