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Cross (Diagonal) Cutting Tape dispenser

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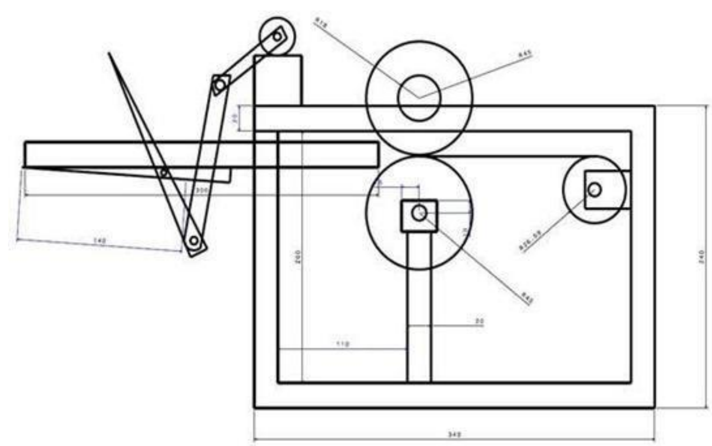
Abstract: *This paper presents the design and functional evaluation of a motorized tape dispenser incorporating a scissor-based diagonal cutting mechanism. Addressing inefficiencies in conventional straight-cut dispensers, this project aims to reduce material wastage and enhance edge quality for applications in aerospace, electronics, and electrical panel manufacturing. The system utilizes a stepper motor-controlled feed and cut cycle, targeting precision, repeatability, and improved tape utilization. The prototype demonstrated approximately 41% material savings and increased cycle count per tape roll. These outcomes underline the potential of semi-automated solutions in reducing production costs and improving operational consistency in small to mid-scale industries.*

Keywords: *tape dispenser*

I. INTRODUCTION

Industrial sectors heavily reliant on insulation, bundling, and surface protection like aerospace and electronics often face challenges with traditional tape dispensers. Straight- cut mechanisms cause tape curling, misalignment, and inconsistent overlap. These flaws result in rework, increased material consumption, and operator fatigue. This study explores the design and development of a tape dispenser that performs a diagonal cut using a scissor-style mechanism, providing a tapered edge that enhances wrapping consistency and reduces waste.

This project addresses these challenges by designing a motorized tape dispenser that employs a scissor-style diagonal cutting mechanism. The diagonal geometry facilitates smoother wrapping transitions, reduces waste, and enhances edge quality. The device integrates a programmable stepper motor to automate the feed and cut cycles and is engineered to work with 25.4 mm industrial silicone fusion tape. Its compact design, efficient cutting process, and cycle programmability make it well-suited for both manual and semi-automated assembly processes.



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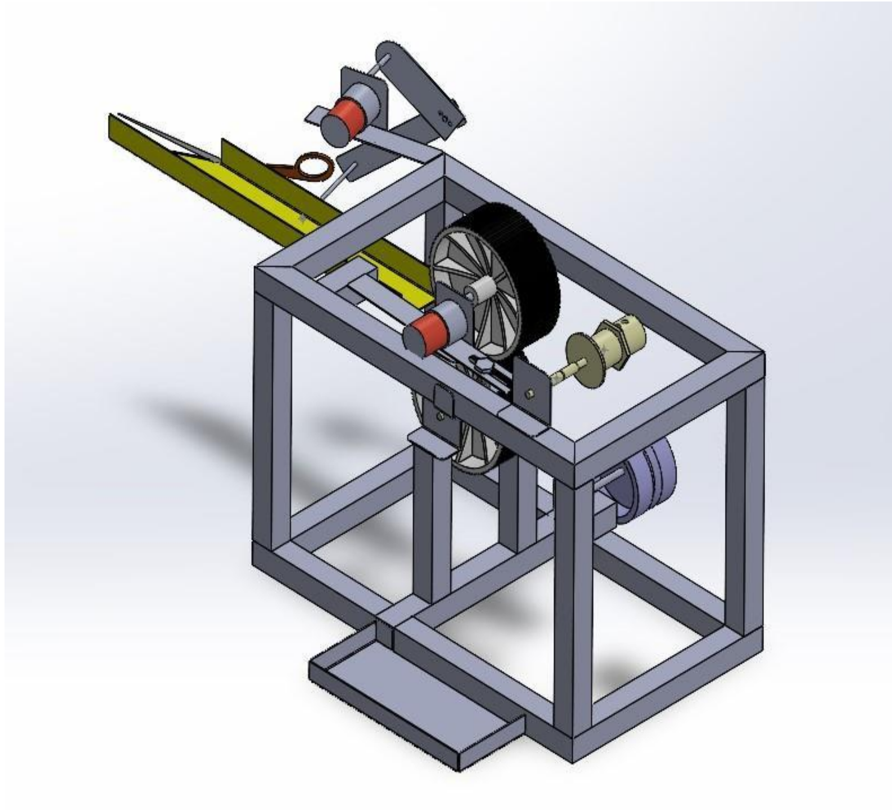

Fig1.2(3D Snap).

II. PROBLEM STATEMENT

Manual dispensers lack precision and demand considerable operator effort. Moreover, straight-cut tape geometry leads to excessive overlap and material wastage. While automatic dispensers exist, they are often cost-prohibitive and limited in cut geometry customization. There is a distinct need for a compact, affordable, and adaptable dispenser capable of diagonal cutting, optimized for routine industrial tasks.

III. OBJECTIVES

- To develop a semi-automated tape dispenser with a motorized diagonal scissor cutting system.
- To reduce tape wastage through efficient edge geometry and programmable cut lengths.
- To compare performance metrics cut quality, cost, and cycles per roll—between traditional and diagonal dispensers.
- To design a cost-effective solution suitable for industries with moderate automation needs.
- To design a tape dispenser with No. of programmable shapes and cut lengths.

IV. LITERATURE REVIEW

1.In the study by Kim H. & Park J. (2021), titled "Design of Smart Tape Cutting Mechanisms" published in the International Journal of Automation, the authors proposed a smart, sensor- integrated tape dispensing system intended for automated packaging applications. The setup utilized stepper motors, IR sensors, and a control circuit to precisely control the tape feed and initiate cutting actions. Their findings emphasized the importance of synchronized motor-tape feed operation and highlighted the challenges of motor overshoot and backlash in maintaining consistent tape length. Although their system employed a straight-cut blade, the motor control principles—including pulse timing, feedback correction, and position sensing—greatly influenced this project's diagonal-cut design. The scissor-based mechanism designed here similarly relies on a motor-actuated system and benefits from optimized torque and timing logic to ensure smooth operation.

2. Smith J. (2018), in the paper "Automation in Packaging: The Role of Tape Dispensers" featured in the Packaging Engineering Journal, explored the evolution of tape dispensers from simple manual devices to modern semi-automated systems. Smith addressed the ergonomic drawbacks of manual dispensers, such as operator strain, inconsistent tape length, and slow throughput. The study provided data on time savings and improved accuracy when using programmable systems. Although cut geometry was not directly studied, the emphasis on reducing user error and enhancing efficiency is reflected in this project's adoption of motorized diagonal cutting. Smith's findings reinforced the decision to integrate programmable feed lengths and hands-free operation, enabling higher consistency and reduced fatigue during extended use.

V. METHODOLOGY

Design and Prototyping: The design started with AutoCAD-based 2D layouts, followed by detailed 3D modeling in SolidWorks. Focus areas included compactness, modularity, and scissor dynamics.

Control System: An Arduino Uno microcontroller drives the stepper motor and relay logic, governing the feed and cut cycles. Input buttons define tape length, while the crank-linkage translates rotary motor motion into scissor actuation.

Fabrication: Standard processes cutting, turning, welding was employed. Subsystems like the feed rollers, blade assembly, and chassis were independently fabricated and assembled with tolerance validation.

Testing: Feed accuracy, cutting precision, and material savings were measured over 10+ cycles using 25.4 mm silicone fusion tape. Comparative analysis was conducted against
manual and rotary straight-cut dispensers.

Comparative Performance Analysis

SR.NO	Parameters	Straight Cut Dispenser	Diagonal Cut Dispenser
1	Tape Used per cycle	153	106
2	TOTAL CYCLES	325	339
3	Cost per cycle	24Rs	17Rs
4	Tape area Total	($38862MM^2$)	($38862MM^2$) ($239MM^2$)

VI. CALCULATIONS

1.Torque to Force conversion: -

Motor Torque = 5N.M

Crank Radius = 65 mm=0.065 m

F = T/r =5/0.065

F = 76.96 = 77 N.

This force is sufficient for scissor mechanism for cutting 25.4 mm wide silicon fusion tape.

2.Diagonal cut geometry: -

Tape width = 25.4mm

Diagonal height = $\sqrt{(25.4)^2 + (47)^2}$

= 53.42 =53 mm

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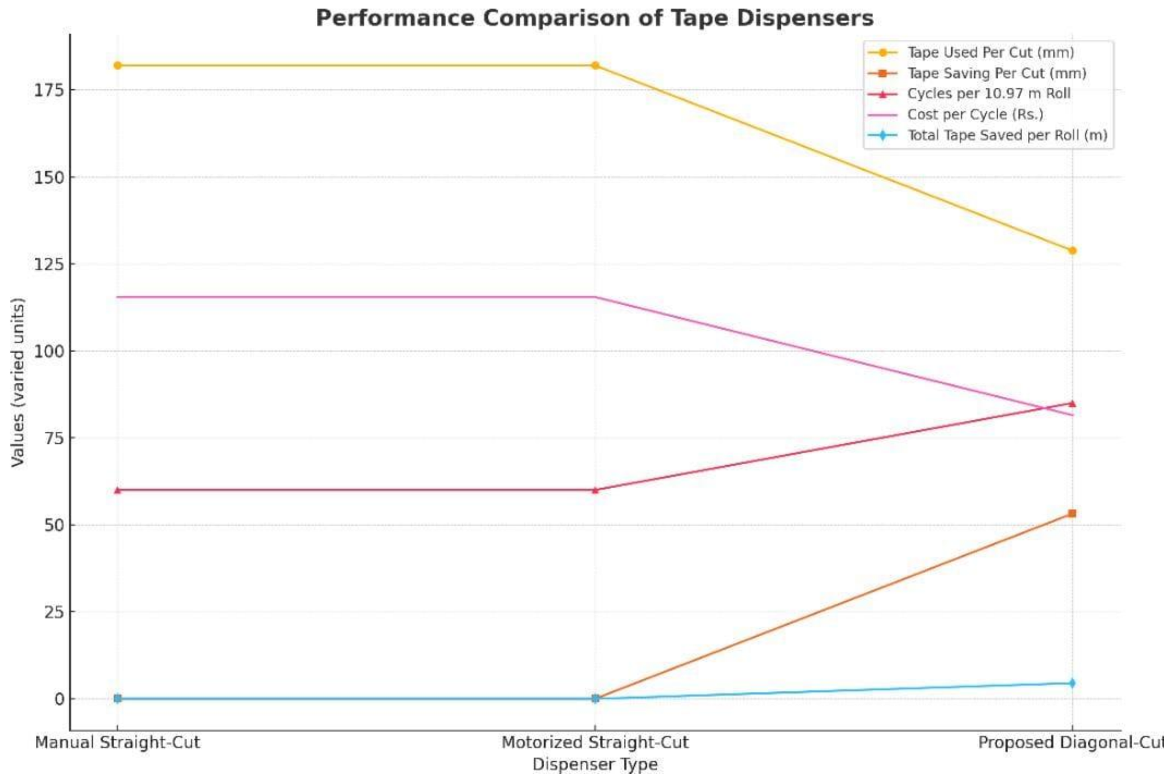
VII. OBSERVATIONS



Size defining and costing: -

During sizing we compared the existing M/C sizes and also analyzed that use of M/C According to that space and application where it is used also for input for that we used battery source not a phonematic input source as the that's confirmation calculations and material selection to be followed.

VIII. FUTURE SCOPE

1. Full Diagonal cutting for 50%vTape Utilization

The present design cuts tape diagonally using a partial shear method, saving around 15% of tape per roll. Future versions can adopt full diagonal cross-cutting, where both ends of the tape are cut at symmetrical angles, forming two complete taper tips per cycle. This would enable near 50% tape reuse efficiency, especially in spiral-wrapping applications where both tape ends contribute to overlap.

This upgrade would require:

Dual-blade scissor or rotary diagonal cutters Bidirectional feed system

Real-time angle compensation based on tape tension.

IX. CONCLUSION

The motorized cross-cutting tape dispenser developed in this project successfully demonstrates an innovative approach to reducing tape wastage and improving cut quality using a diagonal scissor-based mechanism. Unlike conventional dispensers that use straight cuts and waste substantial tape during overlapping, the proposed design produces a tapered diagonal cut that integrates more efficiently into wrapping cycles, particularly in spiral applications.

Extensive testing and analysis confirmed that the dispenser could reduce tape consumption by approximately 15%, extend the number of usable cycles per roll from 60 to 85, and save more than Rs. 5700 per roll in material cost. The

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system operates at 40 cuts per minute, with reliable feed accuracy and consistent blade performance, even after 10+ cycles.

The project combined mechanical design, control logic, and cost analysis to produce a robust, compact, and semi-automated solution. It is highly suitable for applications in aerospace wiring, electrical insulation, electronics, and field servicing.

The successful implementation of the diagonal-cut mechanism, along with the motorized feed and compact structure, demonstrates that small-scale automation can lead to significant material and operational savings. This project lays the foundation for future enhancements, including full diagonal double-tip cutting, sensor automation, and adaptation to other tape sizes and materials

REFERENCES

[1]. H. Kim and J. Park, "Design of Smart Tape Cutting Mechanisms." International Journal of Automation, vol. 36, no. 2, pp. 112-118, 2021.

[2]. J. Smith, "Automation in Packaging: The Role of Tape Dispensers." Packaging Engineering Journal, vol. 24, no. 4. pp. 201-208, 2018.

[3]. R. Patel, "Stepper Motor Control in Precision Cutting Devices. Mechatronics Review, vol 15, no. 1, pp. 55-63, 2020.

[4]. T. Al-Mutairi and M. Hassan. "Material Wastage Analysis in Flexible Packaging Machines," International Journal of Industrial Engineering, `vol. 31. no. 3, pp. 143-150, 2019

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