

DESIGN & FABRICATION OF ECO-FRIENDLY PAPER PEN-MAKING MACHINE



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CERTIFICATION OF APPROVAL

The thesis title is “ **Design and Fabrication of Eco-Friendly Paper Pen Making Machine**” Submitted by Md Tamimul Ahsan ID: **BME2001020074**, Pranto Das Shesir ID: **BME1903019495**, Md Zahirul Isalm ID: **BME2001020206**, Shaykat Islam ID: **BME2001020489**, Riyad Ahmed Fahim ID: **BME2001020562** Session 2019-20 has been accepted as satisfactory partial fulfillment of the requirement for the degree of **Bachelor of Science in Mechanical Engineering** on 18 January 202

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DECLARATION

We, hereby, declare that the work presented in this Thesis is the outcome of the research work performed by us under the supervision of **Prof. Md. Mostofa Hossain, Head of the Department of Mechanical Engineering**, Sonargaon University(SU).

We also declare that no part of this thesis and there has been or is being submitted elsewhere for the award of any degree

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ABSTRACT

ABSTRACT: Traditional plastic pens pose significant environmental challenges due to their reliance on non-renewable resources and polluting production and disposal processes. Eco-friendly paper pen-making machines offer a sustainable alternative, utilizing recycled paper and other natural materials to create biodegradable and compostable writing instruments. This research paper investigates the design, operation, and environmental impact of these machines, analyzing their potential to contribute to a greener writing experience.

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CHAPTER 1

Introduction

1.1 Introduction

Education is the backbone of a human being similarly pen is the backbone of an Educated society. We use pens in our everyday lives in many ways. But the pens we use are normally made of plastic particles. But our goal is to achieve such a pen which saves us from polluting the environment of our beloved planet.

The pen we are going to make will be made up of Recycling papers. Our world needs help. Any kind of help to sustain this global warming situation will be a great help to our world. The use of plastic is also one of the major issues among many more. Every year nearly 430 million tons of plastic products are manufactured and used. [1] But the main disadvantage of using these plastic products is they don't dissolve. They always stay in their made form or shape. Among these plastic products, Plastic pens also hold a great number of 2 billion. But the problem with our regular pens is once the user finishes the ink, they throw it away and as a result, they remain scattered around our earth harming the soil and polluting the environment.

Nowadays people think of global warming because the world we live in is our responsibility to keep it clean and the use of paper pens reduces the impact of 2 billion plastic pen usage.

1.2 Paper pen Potential environmental benefit

Reduce plastic use: Every day, thousands of tons of plastic are being produced in our universe and the amount of plastic used by people is increasing. But this plastic waste is very harmful to our environment and ecology. On the other hand, the paper pen is a pen that is 87% biodegradable.

Reduce Carbon footprint: Using recycled paper in pen production further diminishes its.

Environmental impact: Plastic is primarily made from petroleum, a non-renewable resource. Extracting and refining it pollutes the environment and contributes to climate change. Resource depletion, Deforestation, Landfill waste, Ocean Pollution

Biodegradable: Paper pen ink is eco-friendly and does not harm the environment

1.3 The potential benefit of Automatic paper-making machine

The introduction of automatic paper pen-making machines could revolutionize the industry in several ways.

Increase production capacity: Automation offers the potential for exponentially higher production volume, bringing paper pens to a wider market and postering affordability.

Enhanced Consistency and Quality: Machine-controlled processes can ensure consistent pen size, shape, and functionality, improving product quality and user experience.

Reduced Labor Costs and Waste: Automation can lead to significant cost savings in labor and material usage, making paper pens even more competitive with traditional plastic pens.

1.4 Concept of Automatic Paper Pen-Making Machines

The automatic paper pen-making machine is a fully automated system that produces pens without any human intervention.

It involves steps such as applying glue to paper pulp, guiding the pen through a groove, folding the paper with a servo arm, and reinforcing the glue with a cooling fan. The entire process results in the automatic production of pens

The manufacturing process of paper pens involves several steps and the use of specific materials. This eco-friendly process helps reduce waste.

1.4.1 Manufacturing Steps and Materials

Step	Description	Materials Used
1. Paper Collection	Collecting Designable paper from various sources maintaining the quality of required paper	paper
Step	Description	Materials Used
2. Paper cutting	cut the paper according to the specific size	
3. paper Rolling	Anything that goes between two rolling belts always rolls in the opposite direction	
4. Mixing glue	Mixing of glue at the point where necessary	
5. Pen Assembly	The necessary components such as a blind cap are attached to the last part of the pen, and clips.	
6. Quality Control	Inspecting each pen for quality and functionality, ensuring that they meet the required standards.	

Table: 01 Manufacturing Steps and Materials

1.5 Automatic Machine Operation

The automatic paper pen-making machine is fully automatic. Which can make many pens without any workers. Till a pen is made automatically, this machine has many steps which are described below.

First, an input roller will pick up a paper belt one by one stop at a certain stage, and then brush a certain amount of glue on the paper pulp. After brushing, the pen will whistle through a groove, and the servo arm will fold the paper in two. Also, the cooling fan will strengthen the glue attached to the paper to the whistle. Then the whistled paper completes its specified rolling of paper

The pen will be ready. Which is an automatic process. There are two steps in making paper pens which are cap operation and cutting operation

1.5.1 cap operation

After rolling the paper pen, the diameter of the pen is 0.6 inches. Then the inside blank for the cap would be 0.59 inches. The cap's paper is 1.5 inches. It will automatically rise on a belt and complete rolling on the first roller through two rollers. The cap paper will drop the glue from 2 meters while running on the belt. After the cap rolling, there will be a big pressure pipe on the side of the roller, which will throw the rolling paper to one side with the pipe pressure as the paper cap is rolling, and one cap paper rolling will be complete.

1.5.2 Cutting operation.

A bundle of paper will complete a 12 by 6-inch (12 by 6-inch (12 by 6 by 6) paper cutting) at a certain Pascal pressure. Also, 1.5-inch paper will be cut for the cap. The thickness of this paper will dictate the diameter of the pen.

CHAPTER 2

Literature Review

2.1 Introduction

Paper pen production is becoming increasingly automated, which offers significant advantages in terms of speed, efficiency, and sustainability. Manual labor-intensive, limiting production capacity and increasing costs. Inconsistent quality in pen size, shape, and functionality. Significantly higher output, producing hundreds or even thousands of pens per hour.

2.2 Technical Advancements:

Innovative forming methods: Moving beyond traditional extrusion, rotary molding and press-forming offer precise shaping and faster production speeds.

Bio-based materials: Replacing plastic with plant-based resins for adhesives and coatings reduces emissions and promotes a circular economy.

Robotics and automation: Integrating machine vision, robotic arms, and AI software minimizes human intervention, ensuring consistent quality and high output.[2]

2.3 sustainability:

Life cycle analysis for pens, showcasing notable reductions in environmental impact when using recycled paper and renewable energy. Waste reduction and circularity are highlighted as key priorities, focusing on optimizing material usage, designing for disassembly and recyclability, and incorporating recycled paper. The commitment to energy efficiency involves exploring renewable energy sources and minimizing energy consumption during operation, contributing to overall environmental sustainability in pen production.[3]

2.4 Different Automation

Paper pen-making machines offer a spectrum of automation options, each impacting production efficiency in its way. Choosing the right level of automation requires careful consideration of production needs, budget, and technical capabilities. As technology advances, we can expect

further automation and optimization in these machines, leading to even greater efficiency and a more sustainable future for writing instruments.[4]

2.4.1 Medium Automation:

Partial automation: These machines automate key tasks like paper forming, ink cartridge insertion, and basic quality checks.

Production speed: Output increases compared to low-automation machines, making them suitable for medium-scale production. Labor requirements: Some manual input may still be needed for tasks like setup, troubleshooting, and final inspection.

Example: Machines with automated paper molding, ink cartridge insertion, and conveyor systems for assembly and initial quality checks.[5]

2.4.2 High Automation

Advanced automation: These machines employ robotics, machine vision, and AI for most tasks, including material handling, assembly, and defect detection. Production speed: Output reaches its highest, making it ideal for large-scale production and consistent quality. Labor requirements: Minimal human intervention is needed, mainly for monitoring and maintenance.

Example: Fully automated machines with robotic arms, conveyor belts, and advanced quality control systems.[6]

2.5 Impact on Production Efficiency:

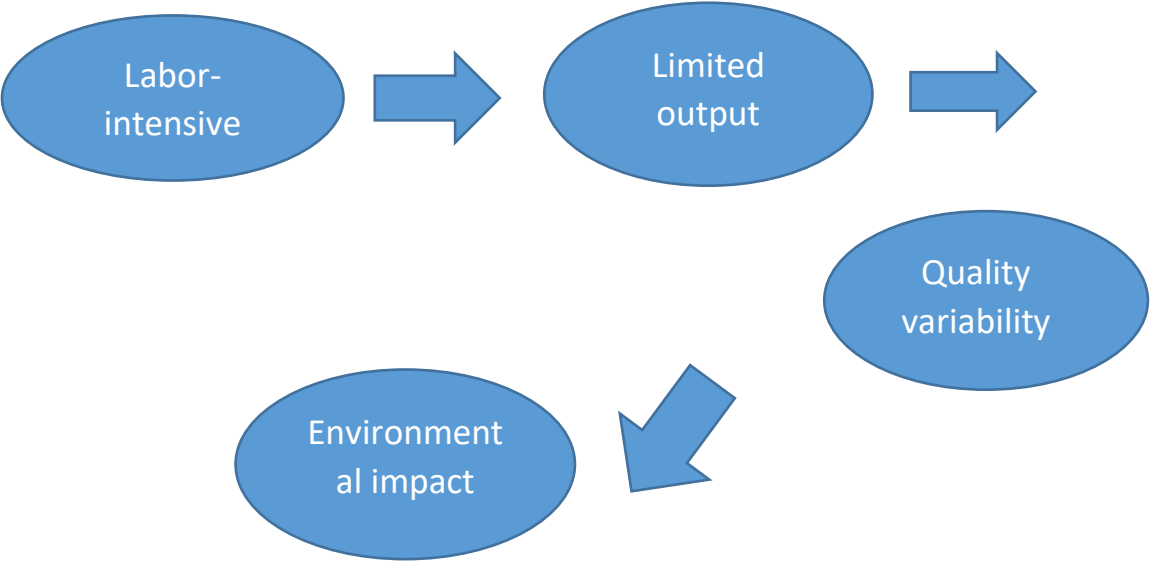
Higher automation generally leads to increased production speed and output. This translates to lower production costs per unit and larger profit margins. Automation reduces reliance on manual labor, minimizing human error and ensuring consistent quality. This improves reliability and reduces the risk of defective products. Automated machines often operate continuously with minimal downtime, maximizing production capacity and efficiency.[7]

2.6 Efficiency Analysis

Paper Pen Production: A Tale of Speed and Sustainability

When it comes to crafting paper pens, the rise of automatic machines challenges the age-old methods. But how do they compare in terms of production speed and output? Let's delve into the fascinating battle of the pens:[8]

2.6.1 Traditional Methods



2.7 Automatic Paper Pen Making Machines

Paper pen machines turbo-charged! These robots crank out pens like crazy, thousands per hour! They get it right every time, too, with no wonky shapes or sizes. And the best part? They can grow or shrink as needed, perfect for big orders or tiny batches. Plus, they're eco-friendly, using recycled paper and green glue. Paper pens, the future is now!

Faster production: These machines leverage automation and robotics to significantly increase output, producing hundreds or even thousands of pens per hour.

Consistent quality: Precise machinery and automated processes ensure uniformity in size, shape, and construction, minimizing errors.

Scalability: Production capacity can be easily adjusted by adding or removing modules, ideal for large-scale manufacturing.

Eco-friendly options: The potential to utilize recycled paper, plant-based adhesives, and sustainable design processes enhances environmental appeal.

2.8 Current State of Paper Pen Production

Paper pen production is still predominantly manual, often in small-scale workshops. The process involves shaping the paper pulp, assembling components, inserting refillable ink cartridges, and finishing touches like painting or branding. While this craftsmanship ensures quality, it limits production capacity, increases labor costs, and restricts accessibility. Manual production also struggles with consistency in pen size, shape, and functionality, potentially impacting consumer trust and adoption.[9]

2.9 Sustainability Assessment of Automatic Paper Pen-Making Machines

Automatic paper pen-making machines offer an increasingly sustainable alternative to traditional plastic pens. While energy consumption and waste generation need careful consideration, advancements in machine design, material choices, and production processes can significantly reduce the environmental impact. Compared to plastic pens, paper pens produced by these machines offer a lower carbon footprint, biodegradability, and potential for sustainable sourcing and production. As advancements continue and consumer awareness grows, paper pens have the potential to revolutionize the writing instrument industry toward a greener future.

2.10 Energy Consumption and Waste Generation:

While automatic paper pen production is generally more sustainable than traditional plastic pens, energy consumption and waste generation still need careful consideration and mitigation strategies.

Utilizing renewable energy, optimizing processes, and minimizing waste through proper disposal and recycling is crucial for ensuring the environmental sustainability of these machines.

2.10.1 Energy consumption:

Variable: Depends on factors like machine size, automation level, and material choices.

Potential efficiency gains:

Utilizing renewable energy sources.

Optimizing machine design and processes for energy efficiency.

Implementing sleep modes and power management systems.

2.10.2 Waste generation:

Minimal scrap paper waste: This can be minimized through efficient material usage and recycling paper dust.

Other waste streams: Ink cartridges, packaging materials, and machine maintenance residuals need proper disposal or recycling strategies.[10]

2.11 Environmentally Friendly Materials and Processes:

The entrepreneurial process of a small business in India within the domain of circular economy and circular value creation. It examines how circular entrepreneurship unfolds and leads to value creation at different levels of paper pen making.[11]

CHAPTER 3

RESEARCH

3.0 Introduction

Paper pen manufacturing lies in sustainable practices and advanced automation. Utilizing durable, recyclable materials, clean manufacturing technologies, and modular designs, along with the incorporation of efficient conveyor belts and automated machines, ensures both environmental responsibility and high production efficiency. The scalability and eco-friendly options of the automated paper pen machines make them adaptable to varying production needs, emphasizing a forward-looking approach to pen manufacturing.

3.1 Machine construction:

Durable and Recyclable Materials:

Stainless Steel: Known for its durability and resistance to corrosion, stainless steel is often used in electronics for structural components. Its recyclability is a significant advantage, as it can be melted down and reused without losing quality.

Aluminum: Lightweight yet strong, aluminum is another popular choice for electronic devices. It is highly recyclable, reducing the need for new raw material extraction. Its lightweight nature also helps in reducing energy consumption during transportation.

Recycled Plastics: Using recycled plastics reduces the demand for new plastic production and helps manage plastic waste. Advances in recycling technology have made it possible to use recycled plastics in various electronic components without compromising quality.

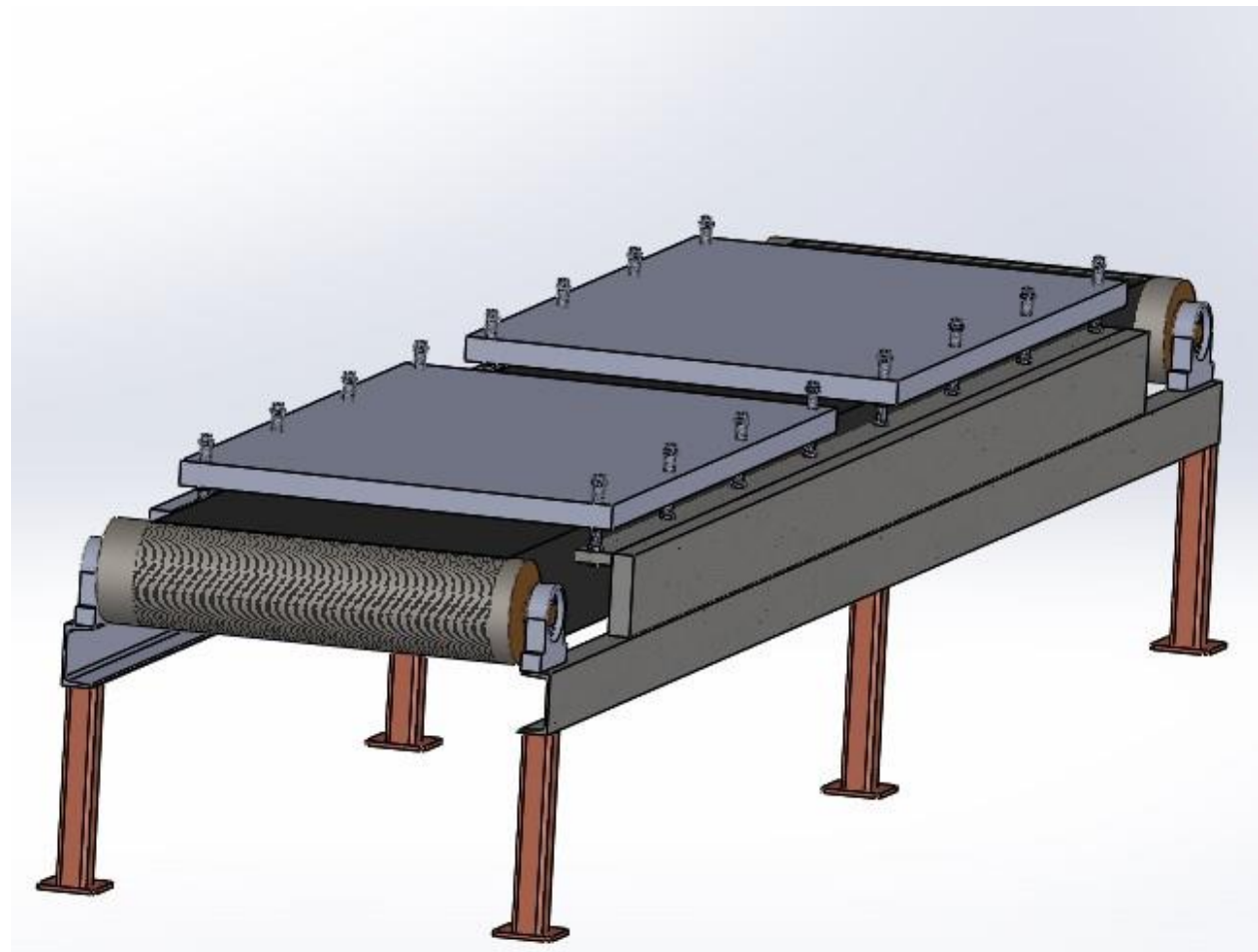
Modular Design:

Ease of Repair and Upgrade: Modular designs allow for easy replacement of individual components rather than discarding the entire device. This extends the product's life and reduces waste.

Customization: Consumers can tailor their devices to their needs, potentially reducing the need for multiple devices.

End-of-Life Recycling: Modular components can be more easily separated for recycling, improving resource recovery.

3.2 Machine Design



The conveyor belt plays a vital role in the paper pen-making process. It transports the paper from one stage of the process to the next, such as from the paper-forming station to the drying station. The conveyor belt must be able to move the paper quickly and efficiently, without damaging it. It must also be able to withstand the wear and tear of the manufacturing process.

3.4 Automatic Paper Pen Making Machines

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Chapter-4

DATA GENERATION

4.1 Introduction

It's a paper pen machine that makes pens to reduce the dependency on regular plastic pens.

4.2 Result

1 paper pen-making process takes 6 seconds by our machine so in 1 hour it can process 600 paper pens.

Chapter-5

Conclusion

Conclusion

Dive into the enchanting realm of paper pen making, where the art of crafting meets the joy of writing. As we embark on this creative journey, discover how ordinary sheets of paper can transform into unique, personalized pens, making every stroke a testament to your imagination and craftsmanship. Join me in exploring the craft of paper pen making and unlocking the door to a world where innovation and writing seamlessly converge.

Reference:

- [1] “Everything you need to know about plastic pollution.” Accessed: Jan. 21, 2024. [Online]. Available: <https://www.unep.org/news-and-stories/story/everything-you-need-know-about-plastic-pollution>
- [2] A. Pacheco *et al.*, “Polymeric Materials Obtained by Extrusion and Injection Molding from Lignocellulosic Agro-industrial Biomass,” *Polymers* 2023, Vol. 15, Page 4046, vol. 15, no. 20, p. 4046, Oct. 2023, doi: 10.3390/POLYM15204046.
- [3] P. Prathap and D. Senthilkumaran, “Reduction of environmental impact by incorporating performance-oriented life cycle assessment,” *Environment Protection Engineering*, vol. 42, no. 1, pp. 113–122, 2016, doi: 10.5277/EPE160109.
- [4] B. R. Gajjar and S. Sheth, “Design and Automation in Back Plug Press Fitting Process of Ball Pen Assembly,” *Applied Mechanics and Materials*, vol. 592–594, pp. 2596–2600, 2014, doi: 10.4028/WWW.SCIENTIFIC.NET/AMM.592-594.2596.
- [5] B. R. Gajjar and S. Sheth, “Investigation of Automation Strategy and Its Effect on Assembly Cost: A Case Study on Ball Pen Assembly Line,” 2014. [Online]. Available: <http://inpressco.com/category/ijcet>
- [6] “Technological Impacts: Manufacturing and the Economy - ProQuest.” Accessed: Jan. 21, 2024. [Online]. Available: <https://www.proquest.com/openview/0ac093167b2a114047387b58fba34502/1?pq-origsite=gscholar&cbl=34845>
- [7] K. C. Yao *et al.*, “An Eco-Innovative Green Design Method using the Theory of Inventive Problem Solving and Importance–Performance Analysis Tools—A Case Study of Marker

- Pen Manufacturing,” *Sustainability* 2023, Vol. 15, Page 14414, vol. 15, no. 19, p. 14414, Oct. 2023, doi: 10.3390/SU151914414.
- [8] K. C. Yao *et al.*, “An Eco-Innovative Green Design Method using the Theory of Inventive Problem Solving and Importance–Performance Analysis Tools—A Case Study of Marker Pen Manufacturing,” *Sustainability* 2023, Vol. 15, Page 14414, vol. 15, no. 19, p. 14414, Oct. 2023, doi: 10.3390/SU151914414.
- [9] R. Ganesan, S. S. Sardar, and M. Marimuthu, “Survey paper on technologies of automatic writing pen,” *AIP Conf Proc*, vol. 2790, no. 1, Aug. 2023, doi: 10.1063/5.0152646/2908097.
- [10] G. A. N. SACHINTHANA, “QUANTIFICATION THE LIFECYCLE IMPACT OF A BALL-POINT PEN,” Nov. 2021, Accessed: Jan. 21, 2024. [Online]. Available: <http://repo.lib.sab.ac.lk:8080/xmlui/handle/susl/3662>
- [11] S. Mohapatra, S. Roy, A. Upadhyay, and A. Kumar, “Circular value creation through environmental entrepreneurship initiatives: A case-based exploration,” *Bus Strategy Environ*, 2024, doi: 10.1002/BSE.3682.