Design and Implementation of Automatic Stapler Machine

A Thesis
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Declaration

A thesis report submitted to the department of mechanical engineering for the partial fulfillment of the award of degree of “Bachelor of Science in mechanical Engineering”.

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Abstract

The most important things in the Office & Desk Accessories mainly comprise of the stapler and punching machine. A stapler is a mechanical device that joins pages of the paper by propelling a thin metal staple through the sheets and then crimping the ends, while a punching machine is used to produce holes by punching dies in the paper, and the paper is being sheared cut. Both these items individually are of utmost importance, but when it comes to carrying them individually or their accessibility at the required time, it creates turmoil, along with this enormous number of resources being consumed for their production resulting in a heap of waste. To deal with this problem a new concept of staunch is put forward which is an integration of stapler and punching machine into a single tool. The new tool is more convenient to use, easy to carry, small in size and lightweight, low production cost, short production time, and offers more design flexibility. Initially, the existing models and designs of staplers and punching machines are taken into consideration their pressing mechanisms are analyzed. The multifunctionality of various tools is also insightful to get a brief idea regarding the integration of functionalities of these two different tools.

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Chapter 1

Introduction

1.1 General

In today's world as we know its era of automation, digitalization as well as people adopting new different methods of working which simplify the work. In our day to days life we use different kinds of machines such as staplers, punches, which are generally used in many fields, means as colleges, offices, industries, government, homes, hospitals, and many other fields. The stapler and punching are becoming very essential for office work. The function of the stapler is to join a bunch of papers using a stapler pin. on the other hand, as the stapler is very essential, punching also plays a key role. It is very useful while making file [1].

A stapler is a mechanical device made for different uses and in many different sizes. It is used to join two or more things, such as papers, tissues or parts, by driving a thin metal staple through them. There are two main types of paper staplers, manual and electric. Manual staplers are normally hand operated, electric staplers are available in variety of different designs and models. Their primary function is to join large number of papers together in rapid succession. The average lifespan of paper staplers is about 5 to 8 years [2].

A hole punch or paper puncher or punching machine is a common office tool which is used to create holes in sheets of paper, often for the purpose of collecting the sheets in a binder or folder. In nowadays there are different types of paper punch are available which are classified as single hole paper punch, double hole paper punch as well as multiple hole paper punch. But generally most commonly used is double hole paper punch [3].

People are doing most of his work with the help of tools, gadgets, and appliances. Multifunctional tools are being developed to integrates these tools and thus reduce the number of tools in the working environment. In multifunctional tools, more functions come together and combine their power into single product. The several advantages of multifunctional tools which reduces material handling time and cost of the product. This study aims at developing concepts for a multifunctional tool which can perform the functions of both the stapler and the punch [4].

A stapler is most commonly used in day-to-day life. A stapler is made up of plastic, stainless steel and zinc plated steel. These are most commonly material used to manufacture stapler. In this project, we are created stapler body die. Because of most stapler are made in china, for Indian manufacturers we going to design and manufacture stapler body die for stapler body. In this project, we are making progressive die for stapler body, which will easily to manufacture, and due to using standard assembly parts, it is easy to replace for maintenance [5].

Lifecycle assessment (LCA) is an objective process for evaluating the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials used and wastes released to the environment; to assess the impact of those energy and materials used and releases to the environment; and to identify and evaluate opportunities to effect environmental improvements [6,7]

1.2 Objectives

The Objective of the Project is:

- Automate the stapling process to reduce human effort.
- Ensure accurate and consistent stapling at the correct position.
- Provide user control through a simple push-button interface.
- Improve productivity and speed in document processing tasks.

Chapter 2

Literature Review

2.1 Background

A stapler is a mechanical device produced for several different uses and in many different sizes. The basic principles behind the workings of each of them remain the same. Essentially, they are used to join two or more things, such as papers, tissues, or parts, together by driving a thin metal staple through them. They are utilized in the manufacture of furniture, carpet tacking, electrical wire and insulation installation, picture frame manufacture, in homes, and offices [8,9].

This study examined a stapling machine that is used to join sheets of paper together. There are two main types of paper staplers: manual and electric. Manual staplers are normally hand-held. Electric staplers exist in a variety of different designs and models. Their primary operating function is to join large numbers of paper sheets together in rapid succession [10,11].

Figure 2.1 shows a Swingline stapler 545TM analyzed in this study [12]. Paper staplers are widely used in government, business, offices, homes, and schools all over the world. The widespread use of paper staplers implies that large quantities are manufactured, distributed, and purchased annually. The average lifespan of a paper stapler is about 5 - 8 years. This relatively short lifespan, coupled with widespread use, implies that a large number of stapling machines are disposed of annually.

It also implies that a large number of resources are consumed in the manufacturing and distribution of staplers. These enormous amounts of resource consumption and waste generation could have significant negative impacts on human health and the environment. It then becomes necessary to evaluate the potential environmental burden that could result from manufacturing, distribution, and end-of-life management of stapling machines.



Figure 2.1: A Swing Line Stapling Machine Model 545XX

Conducting an LCA of a stapling machine becomes necessary because environmental issues have been gaining prominence both in the private and public sectors in the last three decades. The focus is shifting from site-specific environmental degradation to include remote impacts of our industrial activities. There is also an increasing number of customers who are interested in the environmental information of our commonly used products. LCA provides comprehensive information on the environmental burdens associated with products and processes. It also enables us to assess the impacts of those burdens on humans and various ecosystems [13].

Moreover, there is an increasing use of lifecycle assessment in various sectors of our economy and programs. Examples of such programs include LEED certifications for buildings, the formulation of government procurement policies, and pollution prevention programs. Similarly, manufacturing companies are adopting lifecycle assessment, design for environment, and environmental management systems to evaluate their products and to reduce their ecological footprints. Consequently, LCA is an appropriate tool for evaluating the potential environmental impacts of a stapling machine [14].



Figure 2.2: Punch cum Stapler

This concept uses the conventional design of a punch in Figure 2.2 [15]. It has an additional arrangement in the middle for a stapler, as shown in the figure. The stapler and the punch use different handles for their operation. This concept is both very compact and easy to use. It also requires relatively less force for its operation, as the force is applied as a moment through the handle. The only disadvantage of the above concept is that it contains a relatively small stapler pin container.

Advantages:

- **Convenience:** A single device handles both stapling and punching, reducing the need to switch between tools.
- **Space-saving:** A compact design can free up desk space and storage.
- **Cost-effectiveness:** The combined functionality may lead to a lower purchase price compared to buying separate tools.
- **Increased efficiency:** Performing both tasks with one tool can save time and effort.
- **Ergonomics:** The design can be optimized for comfortable handling and ease of use.

Limitations:

- **Increased weight and bulkiness:**

Combining features can make the device heavier and larger.

- **Multiple loading mechanisms:**

The device may require separate mechanisms for stapler pins and punch blades.

- **Potential for design complexity:**

The combined functionality may lead to a more complex design, potentially increasing manufacturing costs or reducing reliability.

- **Reduced capacity:**

The combined design may have a lower capacity for staples or punched pages compared to dedicated tools.

- **Potential for user confusion:**

The multiple functions may require a steeper learning curve or confuse some users.

2.2 Comparison

Conventional Stapler

i. Conventional staplers are not multifunctional.
ii. Conventional staplers have different varieties and different sizes of pins, as well as center stapling is done with the help of a center stapler.
iii. It consists of more parts, so the cost is high, and it takes more time for assembly. iv. As it is not multifunctional that it offers more handling of different staplers.

Modified Stapler

i. The proposed project's stapler is multifunctional.
ii. This stapler consists of all the varieties in a single stapler, i.e., small pin size stapler, medium pin size stapler with center staple.
iii. Due to the DFMA concept, it consists of fewer parts, so the cost is less, and it takes less time for assembly.
iv. As it is multifunctional, it does many functions, and due to its combined product handling is easy.

Chapter 3

Instrument

100 RPM 37 GB Gear motor:

37GB 12V DC 100 RPM High Torque Gear-Box Electric Motor 5W Speed control.100% brand new and high quality. It is great for speed control. Replace your electrical and testing equipment with a new lease of life. Benefit from high torque and low noise. This motor is solidly constructed. This motor is suitable for most high-torque applications.

Swap out a poorly running or downright faulty gearbox motor for this brand new, high-quality 37mm, DC 12V, 100RPM replacement and give your electrical and testing equipment a new lease of life. Benefiting from high torque and low noise, this motor is solidly constructed and ready to install in numerous applications.



Figure 3.1: 100 RPM 37 GB Gear motor

Specification:

Product Name	DC Geared Motor
Rated Voltage	DC 12V
Output Speed	100RPM
Shaft Diameter	6mm

Gearbox Part Size	37mm
Motor Part Size	33 x 29mm
Total Length (Approx)	L

Stapler:

A stapler is a mechanical device that joins pages of paper or similar material by driving a thin metal staple through the sheets and folding the ends. Staplers are widely used in government, business, offices, workplaces, homes, and schools.

The word "stapler" can refer to several different devices of varying uses. In addition to joining paper sheets together, staplers can also be used in a surgical setting to join tissue together with surgical staples to close a surgical wound (much in the same way as sutures).
Most staplers are used to join multiple sheets of paper. Paper staplers come in two distinct types: manual and electric. Manual staplers are normally hand-held, although models that are used while set on a desk or other surface are not uncommon. Electric staplers exist in a variety of different designs and models. Their primary operating function is to join large numbers of sheets together in rapid succession. Some electric staplers can join up to 20 sheets at a time. Typical staplers are a third-class lever.



Figure 3.2: Stapler machine

Methods

- **Permanent fastening** binds items by driving the staple through the material and into an *anvil*, a small metal plate that bends the ends, usually inward. On most modern staplers, the anvil rotates or slides to change between bending the staple ends inward for permanent stapling or outward for *pinning* (see below). Clinches can be standard, squiggled, flat, or rounded, completely adjacent to the paper to facilitate neater document stacking.

- **Pinning** temporarily binds documents or other items. To pin, the anvil slides or rotates so that the staple bends outwards instead of inwards. Some staplers are pinned by bending one leg of the staple inwards and the other outwards. The staple binds the item with relative security but is easily removed.

- **Tacking** fastens objects to surfaces, such as bulletin boards or walls. A stapler that can tack has a base that folds back out of the way, so staples drive directly into an object rather than fold against the anvil. In this position, the staples are driven similar to the way a staple gun works, but with less force driving the staple.

- **Saddle staplers** have an inverted V-shaped saddle for stapling pre-fold sheets to make booklets.

- **Staple less staplers**, invented in 1910, are a means of stapling that punches out a small flap of paper and weaves it through a notch. A more recent alternative method avoids the resulting hole by crimping the pages together with serrated metal teeth instead.

Bearing:

Bearings are "parts that assist objects' rotation". They support the shaft that rotates inside the machinery. Machines that use bearings include automobiles, airplanes, electric generators, and so on. They are even used in household appliances that we all use every day, such as refrigerators, vacuum cleaners, and air-conditioners.

Bearings support the rotating shafts of the wheels, gears, turbines, rotors, etc. in those machines, allowing them to rotate more smoothly. In this way, all sorts of machines require a great many shafts for rotation, which means bearings are almost always used, to the point where they have become known as "the bread and butter of the machine industry". At first glance, bearings may seem like simple mechanical parts, but we could not survive without bearings.



Figure 3.3: Bearings

They fulfill the following two major functions.

Function 1: Reduce friction and make rotation smoother

Friction is bound to occur between the rotating shaft and the part that supports the rotation. Bearings are used between these two components. The bearings serve to reduce friction and allow for smoother rotation. This cuts down on the amount of energy consumption. This is the single most important function of bearings.

Function 2: Protect the part that supports the rotation, and maintain the correct position for the rotating shaft

A large amount of force is needed between the rotating shaft and the part that supports the rotation. Bearings perform the function of preventing damage from being done by this force to the part that supports the rotation, and also of maintaining the correct position of the rotating shaft. This function of bearings is what allows us to use our machines over and over again for an extended period.

Thus, many types of bearings have varying shapes, materials, lubrication, principle of operation, and so on.

There are at least 6 common types of bearing, each of which operates on a different principle:

- **Plain bearing**, consisting of a shaft rotating in a hole. There are several specific styles: bushing, journal bearing, sleeve bearing, rifle bearing, composite bearing;
- **Rolling-element bearings**, whose performance does not depend on avoiding or reducing friction between two surfaces but employ a different principle to achieve low external

friction: the rolling motion of an intermediate element in between the surfaces which bear the axial or radial load. Classified as either:

- **Ball bearing**, in which the rolling elements are spherical balls;
- **Roller bearing**, in which the rolling elements are cylindrical rollers, linearly-tapered (conical) rollers, or rollers with a curved taper (so-called spherical rollers);
- **Jewel bearing**, a plain bearing in which one of the bearing surfaces is made of an ultrahard glassy jewel material, such as sapphire, to reduce friction and wear.
- Fluid bearing, a noncontact bearing in which the load is supported by a gas or liquid (i.e., air bearing);
- **Magnetic bearing**, in which a magnetic field supports the load.
- **A flexure bearing** is where motion is supported by a load element that bends.

Rod:

In mechanical engineering, a rod is a general term for a long, cylindrical bar of material. It can be made of various materials, including steel, aluminum, or other metals, and is used in a wide range of applications. A common example is the connecting rod, which plays a vital role in converting the reciprocating motion of a piston into the rotary motion of a crankshaft in an internal combustion engine. A rod is a long, circular bar of raw material. A dipstick is a metal rod with marks along one end, used to measure the amount of liquid in a container. The connecting rod connects the piston to the crank or crankshaft.



Figure 3.4: Mechanical rods

Design and Materials:

- Connecting rods are often made of drop-forged, heat-treated steel to ensure sufficient strength and durability.
- The design of a connecting rod is crucial for its ability to withstand the forces generated during engine operation, including tensile and compressive loads, as well as vibration.
- Factors like the length, cross-section, and material choice all play a role in the rod's performance and lifespan.

Coupler:

In mechanical engineering, a coupling (also called a shaft coupling or joint) is a mechanical component that connects two shafts to transmit rotational power. It allows power to be transmitted from a driving shaft to a driven shaft while also accommodating some degree of misalignment or other mechanical tolerances.

Key Functions of a Coupling:

- **Power Transmission:**

Couplings transfer rotational motion and torque from the driving shaft to the driven shaft.

- **Misalignment Absorption:**

They can accommodate misalignment between the shafts, which can be due to manufacturing tolerances, thermal expansion, or other factors.

- **Vibration Damping:**

Some couplings can help absorb vibrations from the driving shaft and protect the driven equipment.

- **Heat Transfer Prevention:**

Couplings can be designed to prevent heat transfer from the driving unit to the driven unit.

- **Easy Connection and Disconnection:**

Couplings can provide a quick and easy way to connect and disconnect two components for maintenance or repair.

Mechanical coupling plays a crucial role in connecting two shafts that belong to distinct machines, such as the motor and wheel shafts. Essentially, it facilitates the linkage between the driving and driven shafts. There are instances where a shaft longer than 7 or 8 meters is needed. In such cases, coupling two shafts together allows us to achieve the desired length while minimizing the impact of shocks. The primary purpose of coupling is to join dissimilar shafts, but it's important to note that different coupling types are required due to varying conditions. Today, we will explore the various types of couplings.

The Importance of Coupling:

- Connecting two different machines.
- Transmitting power from the drive shaft to the driven shaft.
- Reducing the impact of shocks on the equipment.
- Eliminating overload problems in equipment.



Figure 3.5: Types of Mechanical Coupling

Types of Mechanical Coupling:

1. Muff or Sleeve Coupling: This is the simplest type of coupling, comprising a hollow cylindrical part called a muff or sleeve. The muff's diameter is manufactured to match the shaft's diameter. The driver and driven shafts are fitted on either side of the sleeve, secured in place by threaded holes and bolts to prevent longitudinal motion. A key and keyway arrangement ensures a slip-free connection between the muff and the shaft. This type of coupling is suitable for transmitting low to medium torque. All components must be adequately strong for proper functioning.

Advantages:
- Cost-effective compared to other couplings.
- Simple construction.
- Consists of only two parts: the sleeve and key.
- Disadvantages:

Unsuitable for misaligned shafts.
- Difficult to assemble and dismantle.
- Limited ability to absorb shocks and vibrations due to its rigid design.

2. Split-Muff Coupling: In this type of coupling, the muff or sleeve is not a single piece but rather made up of two semi-cylindrical parts constructed from cast iron. One part is fitted from above the shaft, while the other is fitted from below. These two parts are joined together using bolts or studs, with two, four, or six holes provided to secure the muffler.

Advantages:
- The main advantage is the ability to assemble and dismantle without changing the shaft position.

3. Flanged Coupling: In flanged couplings, two flanges are brought together and fitted. Both flanges feature the same number of threaded holes, which are used to fasten them using nuts and bolts. A gasket is employed to prevent leakage. Flanged couplings find widespread use and are suitable for medium to heavy-duty applications. To ensure a secure connection with no slippage, a tapered key is utilized.

4. Flexible Coupling: Similar to flanged couplings, flexible couplings incorporate rubber bushings along with nuts and bolts. The rubber bushing, designed with appropriately sized holes, provides enhanced strength to absorb shocks and vibrations more effectively than flanged couplings. Additionally, it accommodates slight misalignments between the shafts. Flexible couplings are commonly employed in medium-duty applications.

5. Oldham Coupling: Oldham couplings consist of two flanges connected by a middle plate. They are used when two shafts are misaligned and have a gap between them. The middle plate is joined to the flanges through a tongue and groove arrangement, with the grooves positioned perpendicular to each other. The key advantage of Oldham couplings is their ability to accommodate high parallel misalignment.

6. Universal Coupling: Universal couplings are employed when two shafts are at an angle. Although the angle may remain constant, it can change during operation. The primary application of universal couplings is in heavy vehicles

7. Gear Coupling: Gear coupling is a specific type of coupling that falls under the category of flange couplings. It differs from standard flange couplings as it comprises separate parts, namely the flange and the hub. It finds application in heavy-duty scenarios where robustness is essential. Two shafts are connected through fixed holes and secured by a third spindle. Gear couplings are particularly suitable when there is an angular displacement of 4 to 5 degrees in the shafts. Generally, they have a 1:1 gear ratio between the internal and external gears.

8. Fluid Coupling: Fluid coupling involves connecting one shaft to the power supply and the other to the power generator shaft. It consists of a pump connected to one shaft and a turbine

connected to the second shaft. Over time, the speed of the pump impeller and the turbine equalize, resulting in power transmission.

Applications:
- Utilized in marine propulsion systems.
- Widely employed in various industries for efficient power transmission.

12V 2A SMPS:

SMPS stands for Switched-Mode Power Supply. It's an electronic power supply that uses switching technology to efficiently convert electrical power from one voltage level to another. SMPS devices are widely used in various electronic devices like computers, smartphones, and TVs.

The power switching stage performs the power conversion from the circuits input voltage, V_{IN} to its output voltage, V_{OUT} which includes output filtering.

The major advantage of the switch mode power supply is its higher efficiency, compared to standard linear regulators, and this is achieved by internally switching a transistor (or power MOSFET) between its "ON" state (saturated) and its "OFF" state (cut-off), both of which produces lower power dissipation.

This means that when the switching transistor is fully "ON" and conducting current, the voltage drop across it is at its minimal value, and when the transistor is fully "OFF," there is no current flow through it. So, the transistor is acting like an ideal ON/OFF switch. Unlike linear regulators, which only offer step-down voltage regulation, a switch-mode power supply can provide step-down, step-up, and negation of the input voltage using one or more of the three basic switch-mode circuit topologies: *Buck*, *Boost*, and *Buck-Boost*. These names refer to how the transistor switch, inductor, and smoothing capacitor are connected within the basic SMPS circuit.



Figure 3.6: SMPS

Key features of SMPS:

- **Efficiency:** SMPS offers higher efficiency compared to traditional linear power supplies.
- **Size and Weight:** They are typically smaller and lighter than linear power supplies.
- **Switching Regulator:** SMPS uses a switching regulator to control the output voltage.
- **High-Frequency Operation:** They operate at high frequencies, allowing for smaller components.
- **Applications:** SMPS are used in a wide range of devices, including computers, televisions, and industrial equipment.

How SMPS Works:

1. **1. First Stage:**

The AC input voltage is converted to a DC voltage.

2. **2. Switching Regulator:**

A switching regulator then converts the DC voltage to the desired output voltage.

3. **3. High-Frequency Switching:**

Semiconductor switches are used to rapidly turn the DC voltage on and off, creating a high-frequency signal.

4. **4. Output:**

The filtered and regulated high-frequency signal is then converted back into a DC output voltage.

Limit Switch:

A limit switch is an electromechanical device that uses physical interaction to send an electrical signal. It's essentially a switch that's activated by the motion of a machine part or the presence of an object, often used to detect the end of a travel or the presence of something.

A limit switch is an electromechanical device operated by a physical force applied to it by an object. Limit switches are used to detect the presence or absence of an object. These switches were originally used to define the limit of travel of an object, and as a result, they were named Limit Switch.

A limit switch is a simple device. The lever is used to close a contact within the switch. When the contact is closed, it allows the electrical signal to go through. The mechanical operation is similar to that of a light switch. However, a spring is added to return the limit switch into its original position.

The critical parameter of a limit switch is at which point it closes the contact within. This parameter will vary between switch types as well as brands. It is important to verify the datasheet to confirm this position. It will influence the system design that will utilize the limit switch.



Figure 3.7: Limit switch

Key Features and Components:

- **Actuator:**

The part that physically interacts with the object or machine part being monitored.

- **Switch Mechanism:**

The internal component that opens or closes the electrical circuit when activated.

- **Electrical Terminals:**

For connecting the switch to the control circuit.

- **Housing:**

A protective casing, often made of metal or resin, to shield the switch from environmental factors.

Common Applications:

- **Position Detection:** Determining the position of a machine part, such as a valve, conveyor belt, or door.
- **Safety Interlocks:** Stopping machinery movement if a safety condition is not met.
- **Counting:** Enumerating objects passing a point.
- **Automation:** Controlling the sequence of operations in automated systems.
- **Furnace Control:** Monitoring temperature and preventing overheating.
- **Other applications:** Refrigerator door status, garage door movement, and more.

8mm Shaft Support



Figure 3.8: 8 mm Shaft Support

These SHF8 Supports are usable with our 8mm Smooth Rods, you can simply slide the rail through then tighten the clamp screw at the top to fix it in place. Then use our M5 Screws to attach them. If you need to disassemble or otherwise repair your machine, simply open up the clamp and remove the rail.

Cam



Figure 3.9: CAM

A cam is a mechanical component designed to convert rotational motion into linear or reciprocating motion. It typically features a specially shaped profile that interacts with a follower, causing it to move in a predetermined manner as the cam rotates. This mechanism is fundamental in various machines where precise timing and motion control are essential.
By designing the cam's profile appropriately, engineers can achieve complex and precise motion sequences, making cams indispensable in mechanical design and automation.

Chapter 4

Methodology

4.1 Working Process

A smart stapler cum punching system, often referred to as a "Staunch", combines the functionalities of a stapler and a hole punch into a single device. It allows for both stapling and punching operations, typically with independent mechanisms for each function. This design aims to reduce the space and cost associated with using separate tools.
Here's a more detailed breakdown of the working process:

1. Stapler Mechanism:

- The stapler mechanism involves a spring-loaded arm that pushes staples through the paper.
- A lever or handle is used to activate the stapling action, typically with a separate section for holding the staple pins.
- Some designs incorporate adjustable depth settings to accommodate different paper thicknesses.

2. Punching Mechanism:

- The punching mechanism uses a punch die to create holes in the paper.
- A handle or lever is used to depress the punch die, creating holes in the paper.
- Some designs may have adjustable depth settings for the punch die, similar to the stapler.

3. Combined Operation:

- The smart stapler cum punching system is designed to allow for either stapling or punching, or even both, in a single unit.
- Independent mechanisms for each function allow for easy switching between the two operations.
- Some designs might feature a lever or button to switch between stapling and punching.

4. Additional Features:

- Some designs may incorporate features like adjustable depth settings for both the stapler and the punch.

- Some models might also include a waste container to collect the punched paper waste.

5. Benefits of the Combined Design:

- **Space Savings:** It reduces the need for separate staplers and hole punches, saving space in offices and homes.
- **Cost Savings:** Eliminating the need for separate tools can lead to cost savings.
- **Convenience:** It provides a one-stop solution for both stapling and punching operations, making it more convenient for users.

4.2 Block Diagram

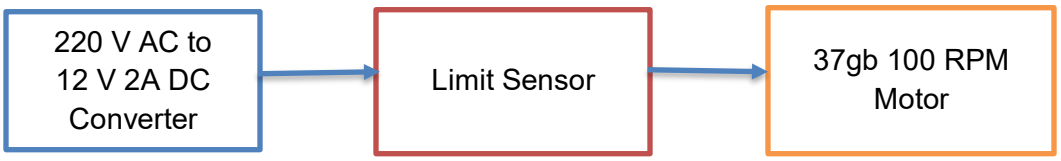


Figure 4.1: Electrical Cycle

Process:

The smart stapler cum punching system is designed to save space and cost by combining stapling and punching operations in a single unit. The stapler mechanism uses a spring-loaded arm to push staples through paper, with a handle or lever for activating the action. Some designs have adjustable depth settings for different paper thicknesses. The punching mechanism uses a punch die to create holes in paper, with a handle or lever for depressing the die. Some designs may have adjustable depth settings for the punch die. The system also allows for easy switching between stapling and punching, with some designs featuring a lever or button for switching between the two operations.

4.3 Circuit Diagram

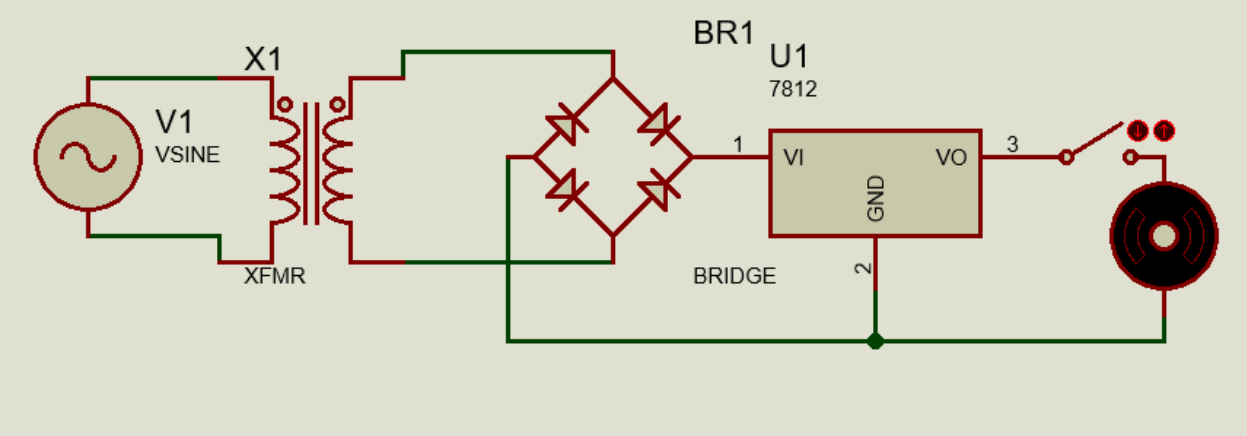


Figure 4.2: Mechanical cycle

Process: A system with a mechanical cycle consists of two independent mechanisms for stapling and punching, which can be activated individually. The system is compact and easy to use, reducing the need for multiple tools. The stapler mechanism inserts staple cartridges, drives the staple through the paper, and some systems may have a built-in staple remover. The punching mechanism extends punch dies using a joining mechanism to create holes, which can be returned to their original position. The joining mechanism may maintain a specific distance between holes.

4.4 Flow Chart

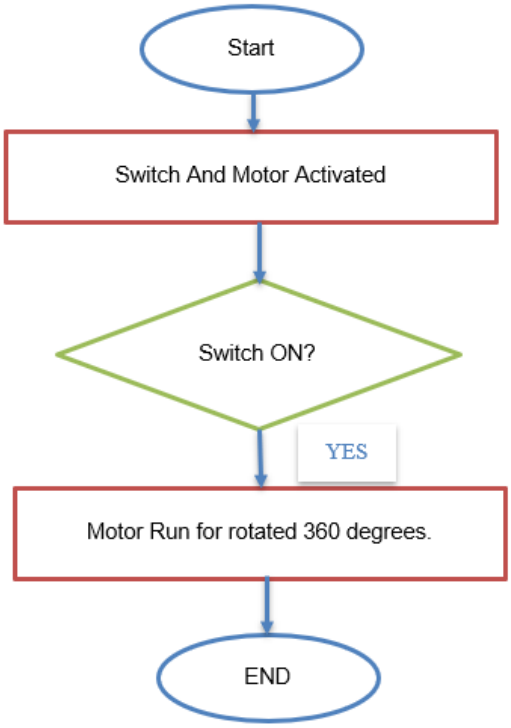


Figure 4.3: Flow Chart

4.5 Final View of the Project

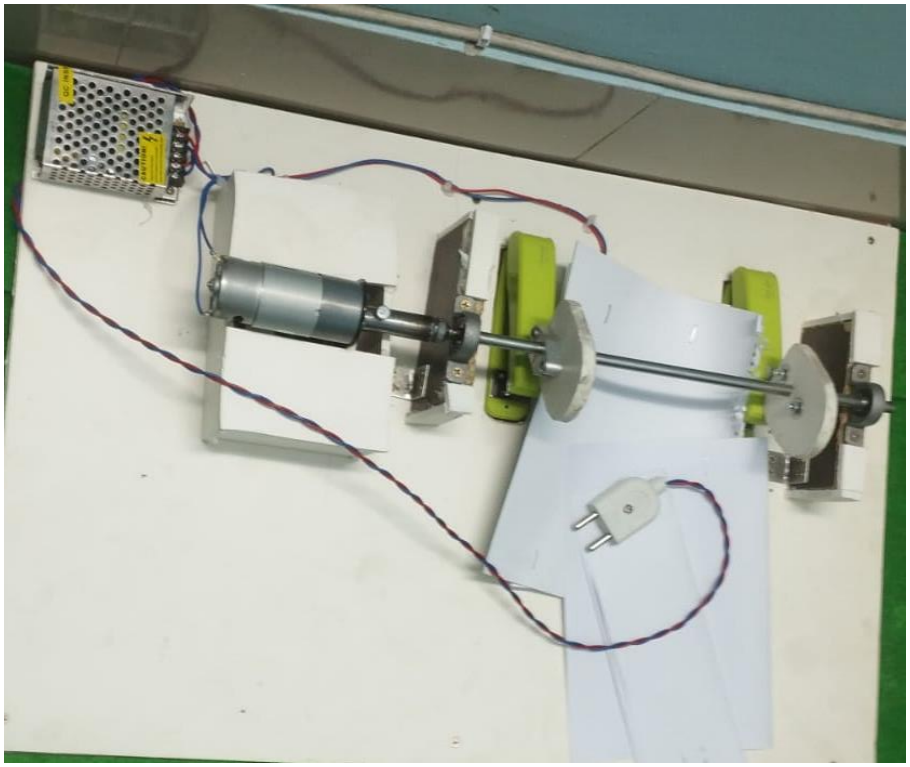


Figure 4.4: Automatic Stapler Machine

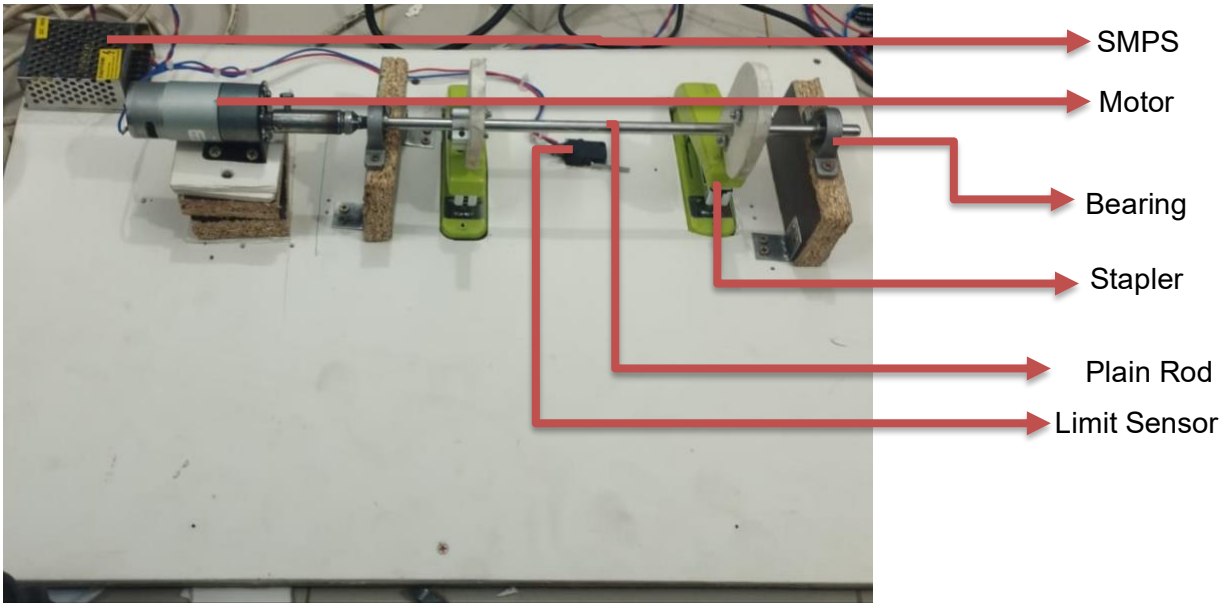


Figure 4.5: Marking All Components.

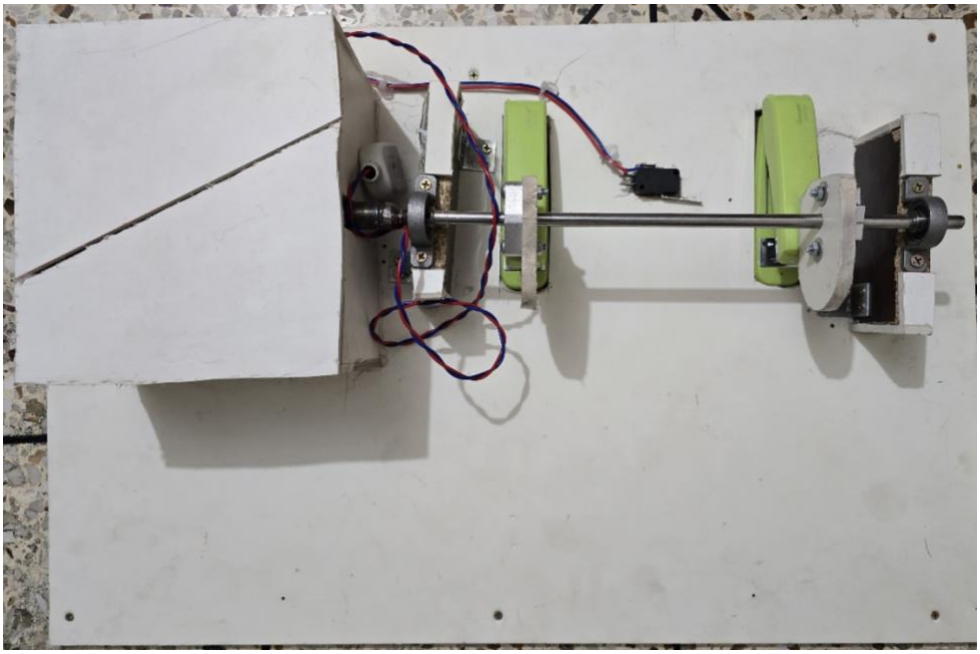


Figure 4.6: Upper View of Project

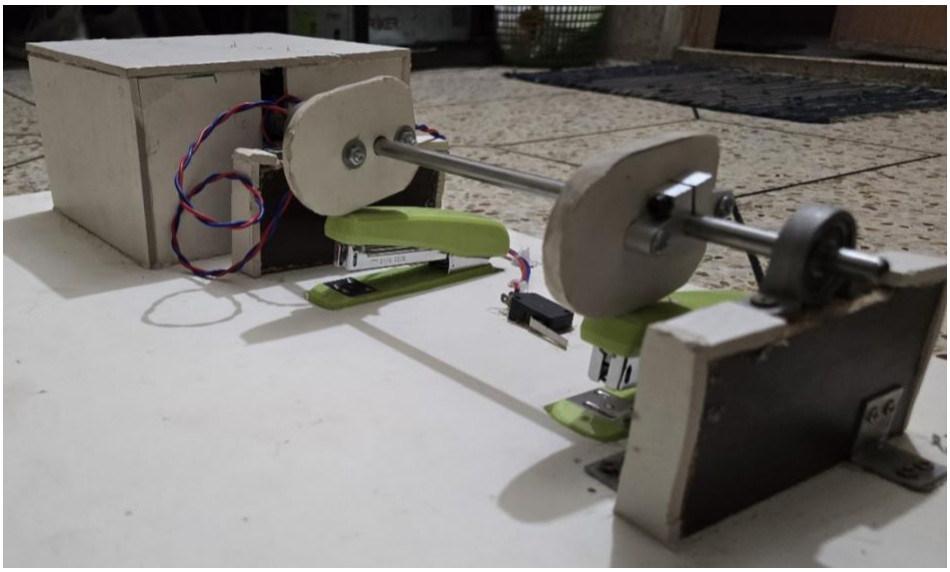


Figure 4.7: Side View of Automatic Stapler Machine.

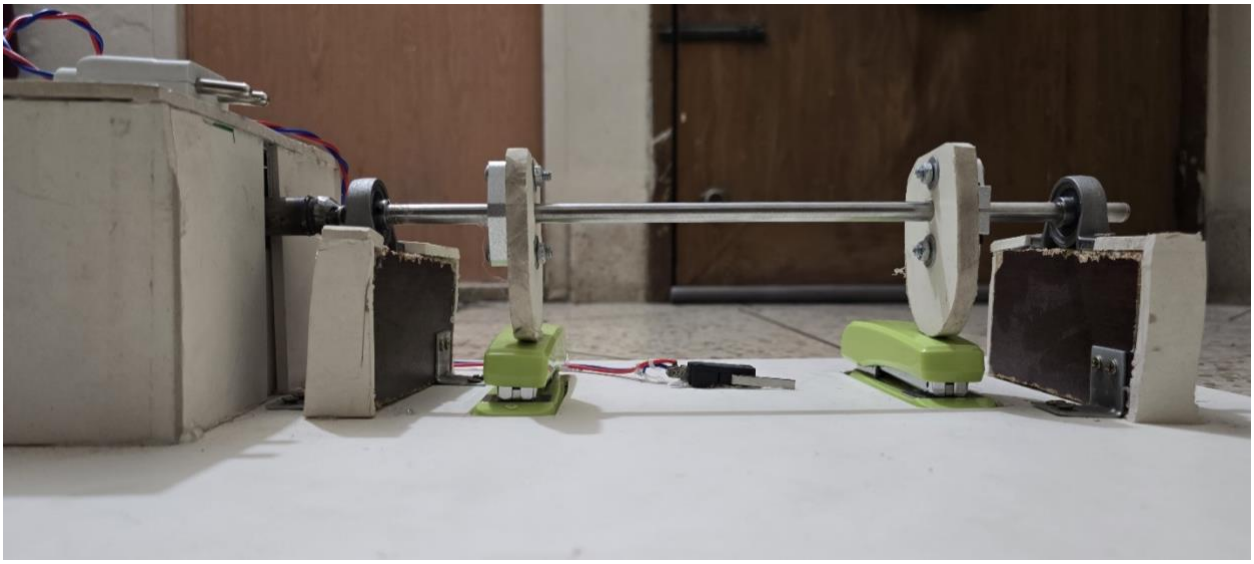


Figure 4.8: When Press Stapler for attached Stabler Pin

Chapter 5

Results and Discussion

5.1 Result

Table 5.1: Data table of stapling Time

SL. No	Total Time (in Sec)	Page
1	1	2
2	1.5	3
3	2	4
4	3	5
5	3.2	6
6	3.3	7
7	3.5	8
8	4	9
9	4	10

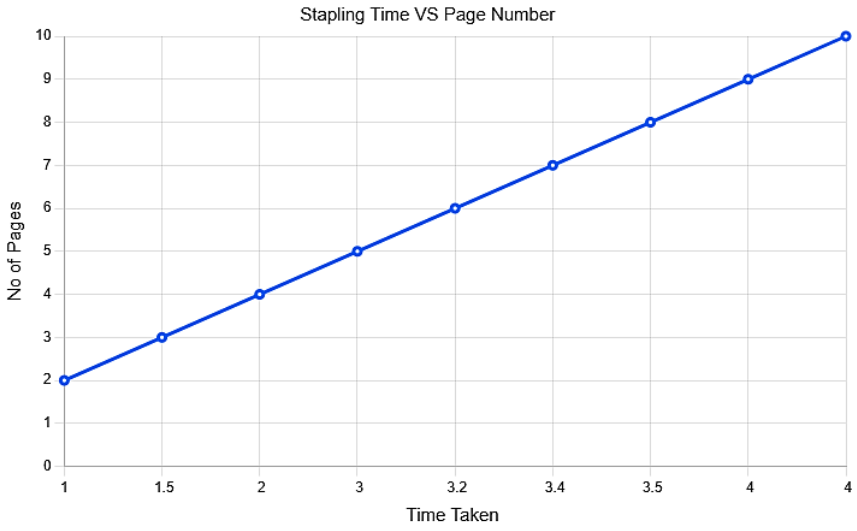


Figure 5.1: Graph of Stapler Time vs Page Number

A graph depicting stapler time versus page number would typically show a sloping line. As the number of pages increases, the time it takes to staple them will also generally increase. The slope of the line would likely be influenced by factors like the type of stapler and the thickness of the paper.

Table 5.2: Device Rating

Serial No.	**Components Name**	**Rating**
01	SMPS	12 V 2 A
02	Motor	12 V 100 RPM
03	Plain Rod	8 mm 14 inchi
04	Bearing	8 mm 624
05	Limit Switch	10A

5.2 Applications of the Automatic Stapler Machine:

- Offices and Corporate Environments

i. Fast and effortless stapling of reports, documents, and files.

ii. Reduces time and manual effort in paperwork-heavy departments.

- Schools, Colleges, and Universities

i. Assists teachers and administrative staff in preparing exam papers, assignments, or notices quickly.

ii. Useful for library documentation and record-keeping.

- Printing and Copy Shops

i. Speeds up the binding of printed materials, especially when dealing with bulk orders.

- Banks and Financial Institutions

i. Automates stapling of forms, account papers, loan documents, etc., enhancing customer service speed.

- Government Offices and Registration Departments

i. Useful for organizing official paperwork in high-volume processing areas.

- Factories and Industrial Documentation Units

i. Used in quality control departments for report bundling, shipment papers, and compliance checklists.

- Disabled or Elderly Assistance

i. Helpful for people with limited hand strength or dexterity by making stapling easier.

5.3 Limitations of the Automatic Stapler Machine:

- Limited Paper Capacity
- Manual Alignment Required
- Single Staple Position
- Electrical Power Dependency
- Mechanical Jamming
- No Auto Paper Detection
- Safety Risks
- Limited Intelligence

5.4 Discussion

This system is a versatile tool that combines the functions of a stapler and a paper punch into a single device. This design reduces the need for carrying multiple tools, especially for tasks requiring both stapling and punching. The punching mechanism is integrated with the stapler, allowing users to perform both operations with a single device. Key features include convenience, space savings, efficiency, and reduced waste. The design considers independent mechanisms for the punching and stapling mechanisms, integrated punching for easy use and retraction when not in use, and compactness for easy handling. The system has potential applications in office settings, crafting and DIY projects, and education for students and teachers working with documents and materials. The punching mechanism is often designed to operate independently, ensuring that one function doesn't interfere with the other.

Chapter 6

Conclusions and Future Scope

5.1 Conclusion:

In conclusion, the smart stapler-punch offers a practical and efficient solution for combining the functions of a stapler and a punch, streamlining document preparation, reducing resource consumption, and offering potential cost savings.

The study investigated different parameters dealing with the design of the stapunch for integrating a stapler and punching machine. It started with a briefing on the basic use of a stapler and punching machine, and the objectives of integrating them. A survey carried out depicted the different tools with the same ideology and the flaws within them. Important factors were the basic design parameters and the feasible tool required. Material selection was carried out to reduce the weight. Analysis helped in calculating the force required for punching. Thus, a combined tool with multifunctionality of punching holes and stapling was designed for convenient use and to reduce the wastage of resources used to produce both of them.

The project is based on the Design for Manufacturing and Assembly (DFMA) concept. According to that concept, some parts are reduced. So, the time required for assembly is less. By considering the unavailability of the product in the market, this project is modified as a hybrid of the stapler and punching machine. It includes different functions which do their work in a single product, such as small size pin staple, medium size pin staple, punching with automatic center, and center staple. This is the best combination of products by considering things as analysis results, market surveys.

With this modification of the project, it concludes that finding less expensive parts of the product is a necessity in the current situation in offices, Xerox shops, colleges, etc. This project has a lower manufacturing cost as compared to a conventional product.

5.2 Future Scope for Improvement:

Sensor-Based Automation

Integrate IR or proximity sensors to detect paper presence and trigger stapling automatically, removing the need for a manual switch.

Microcontroller Integration

Use Arduino, ESP32, or similar controllers to add smart features like:

Paper alignment checking.

Auto-stapling at different positions.

Monitoring staple count.

Touchless Operation

Replace the switch with a gesture sensor or touchless IR sensor for hygienic, hands-free use.

Multiple Staple Positioning

Design a system that can move the stapler head or paper holder to staple in multiple predefined positions (e.g., top-left, center, or side).

Auto Paper Feeder Mechanism

Include a motorized paper feeder to automatically feed and staple bulk documents in sequence.

Safety Features

Add a safety lock mechanism or finger detection sensors to prevent accidental stapling during hand placement.

Battery Backup

Include rechargeable battery support for uninterrupted use during power failures.

Staple Level Indicator

Add a sensor to detect staple levels and notify users when the stapler is empty.

Integration with Office Systems

Connect to a PC or IoT platform to staple documents as soon as a print job is completed.

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