

AUTOMATIC PAPER CUTTING MACHINE USING GENEVA MECHANISM

A thesis report submitted to the department of mechanical engineering for the partial fulfillment of the degree of Bachelor of Science in Mechanical Engineering

A thesis

by

MD Ashikur Rahman	ME2203028357
MD Zahidul Islam	ME2203028363
Imran	ME2103025096
Motasim Abir	ME2203028312
Islam Uddin	ME2203028311

.....
Supervisor:

Md. Minhaz Uddin

Assistant Professor of Mechanical Engineering



DEPARTMENT OF MECHANICAL ENGINEERING
SONARGAON UNIVERSITY (SU)
Dhaka, Bangladesh

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APPROVAL

This is to certify that the project on "**Automatic Paper Cutting Machine Using Geneva Mechanism**" By MD Ashikur Rahman (ID No: ME2203028357), MD Zahidul Islam (ID No: ME2203028363), Imran (ID No: ME2103025096), Motasim Abir (ID No: ME2203028312) and Islam Uddin (ID No: ME2203028311) has been carried out under our supervision. The project has been carried out in partial fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of years of 2026 and has been approved as to its style and contents.

.....

Md. Minhaz Uddin

Assistant Professor of Mechanical Engineering

Sonargaon University (SU)

DECLARATION

We, hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of **Md. Minhaz Uddin**, Assistant Professor, Department of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thesis has been or is being submitted elsewhere for the award of any degree.

MD Ashikur Rahman
ID No: ME2203028357

MD Zahidul Islam
ID No: ME2203028363

Imran
ID No: ME2103025096

Motasim Abir
ID No: ME2203028312

Islam Uddin
ID No: ME2203028311

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[Authors]

MD Ashikur Rahman

MD Zahidul Islam

Imran

Motasim Abir

Islam Uddin

ABSTARCT

The “Automatic Paper Cutting Machine Using Geneva Mechanism” is a mechanical automation project designed to perform accurate and continuous paper cutting operations with reduced human effort. The main purpose of this project is to improve cutting precision, increase production speed, and minimize material wastage in paper processing industries and small-scale workshops. The system uses a Geneva mechanism to convert continuous rotational motion into intermittent motion, allowing the paper feeding process to occur step-by-step in a controlled manner. In this project, a motor drives the Geneva wheel, which controls the movement of the paper feeding roller. After a fixed interval of paper movement, the cutting blade operates automatically to cut the paper into equal sizes. The synchronization between the feeding mechanism and cutting section ensures uniform cutting accuracy and smooth operation. The machine is designed using simple mechanical components, making it cost-effective, reliable, and easy to maintain. This project demonstrates the practical application of mechanical automation and motion control systems. It can be used in printing industries, packaging industries, educational laboratories, and small manufacturing sectors where repetitive paper cutting operations are required efficiently and safely.

TABLE OF CONTENTS

Approval.....	ii
Declaration.....	iii
Acknowledgement.....	iv
Abstract.....	v
Table of Figure.....	viii

CHAPTER-1 INTRODUCTION

1.1 Introduction.....	01
1.2 Problem Statement.....	02
1.3 Objectives.....	03
1.4 Work Flow Diagram.....	03

CHAPTER 2 : LITERATURE REVIEW

2.1 Introduction.....	05
2.2 History.....	05
2.3 Literature Survey.....	06
2.4 Summary.....	09

CHAPTER 3 : MATERIALS AND INSTRUMENT

3.1 Introduction.....	10
3.2 Required Instrument.....	10
3.3 SMPS.....	10
3.4 Buck Converter.....	15
3.5 Gear Box.....	16
3.6 Bearing	17
3.7 Geneva Wheel.....	18
3.8 Chain Sprocket.....	19

CHAPTER 4 : METHODOLOGY

4.1 Our Methodologies for The Project.....	21
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4.2 Overview our Project.....	21
4.3 Block Diagram.....	24
4.4 Working Principle.....	25
4.5 Experimental Setup of our System.....	25

CHAPTER 5 : RESULT ANALYSIS

5.1 Project outcome.....	27
5.2 Advantages.....	28
5.3 Application.....	28
5.4 Limitation.....	28
5.5 Discussion.....	29

CHAPTER 6 CONCLUSION

6.1 Conclusion.....	30
6.2 Future Scope.....	30

Reference.....	31
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LIST OF FIGURES

Figure 1.1 : Geneva Machanism	02
Figure 1.2 : Work Flow Diagram.....	04
Figure 3.1 : SMPS.....	11
Figure 3.2 : SMPS Circuit.....	12
Figure 3.3 : SMPS Circuit Connection.....	14
Figure 3.4 : DC Power Supply Way.....	14
Figure 3.5 : DC-DC Buck Cnverter.....	15
Figure 3.6 : Gear Box.....	17
Figure 3.7 : Bearing	18
Figure 3.8 : Geneva Wheel.....	19
Figure 3.9 : Chain Sprocket.....	20
Figure 4.1 : Overview of the paper Cutting Machine.....	21
Figure 4.2 : 3D view Our Project.....	22
Figure 4.3 : 3D view Shaft Distance.....	23
Figure 4.4 : 3D View Geneva Mechanism.....	23
Figure 4.5 : 3D view Cutting Blade.....	24
Figure 4.6 : Block Diagram of our project.....	24
Figure 4.7 : Our ystem Structural Frame Setup.....	25
Figure 4.8 : Our System Wiring Implementation.....	26
Figure 4.9 : Project Final image.....	26

CHAPTER 1

INTRODUCTION

1.1 Introduction

Now a days, there is lot of competition in the market. So there is need of developing a new method or process for effective manufacturing. That process or methods should fulfill the requirement about accuracy Productivity. This paper represents the automatic paper cutting machine by using Geneva mechanism. This equipment is very accurate to cut the papers. This concept will be mainly used in the paper manufacturing industry to cut the papers in huge numbers. The equipment is fabricated in less cost and good efficient. The aim of this concept is to reduce the human fatigue and time savings in industries by eliminating the paper marking time. Here it has analyzed to use Geneva Mechanism. This is the mechanism used to get intermittent motions. This mechanism consists of the following parts like Geneva wheel, rotating disc, bearing, frame and DC motor. In industries the paper cutting machines go through a time taking process of paper marking which is required to cut the paper of required dimensions, so this model is designed by using Geneva mechanism which eliminates the paper marking time and feeds the paper of equal length in each rotation. Geneva mechanism is used as a mechanism for transforming rotary motion into intermittent motion running with acceleration jumps at the beginning and the end of the active phases. The rotating drive wheel has the pin that reaches into a slot of the driven wheel advancing into it by one step. The drive wheel also has a raised circular blocking disc that locks the driven wheel in position between steps. The Geneva drive or Maltese cross is a gear mechanism that translates a continuous rotation into an intermittent rotary motion. The rotating drive wheel has a pin that reaches into a slot of the driven wheel advancing it by one step. The drive wheel also has a raised circular blocking disc that locks the driven wheel in position between steps. In the most common arrangement, the driven wheel has four slots and thus advances by one step of 90 degrees for each rotation of the drive wheel. If the driven wheel has n slots, it advances by $360^\circ/n$ per full wheel rotation of the drive wheel. A four bar mechanism is a basic 1 degree of freedom mechanism. A 4 bar is created by selecting four link lengths and joining the links with revolute joints to form

a loop. A wide variety of paths are possible by arbitrarily choosing a point on the coupler curve. These different curves can be obtained by constructing a physical model of the mechanism and viewing the path of various points without detailed mathematical analysis. It is also possible to develop a mathematical model of the mechanism in terms of its four link lengths. The analytical expressions for these paths are algebraic and require many computations to determine the coordinates for points on the path. A procedure to determine the link lengths of a 4-bar mechanism that will guide its coupler curve in a prescribed manner. The mathematical formulation of this procedure for designing a 4-bar mechanism. The use of a computer for the design of 4-bar mechanisms. This activity precipitated much interest in creating additional analytical approaches to specify mechanisms capable of satisfying a desired task. Interestingly, the number of points is usually three, four or five. This methodology of path generation is referred to as an exact method.

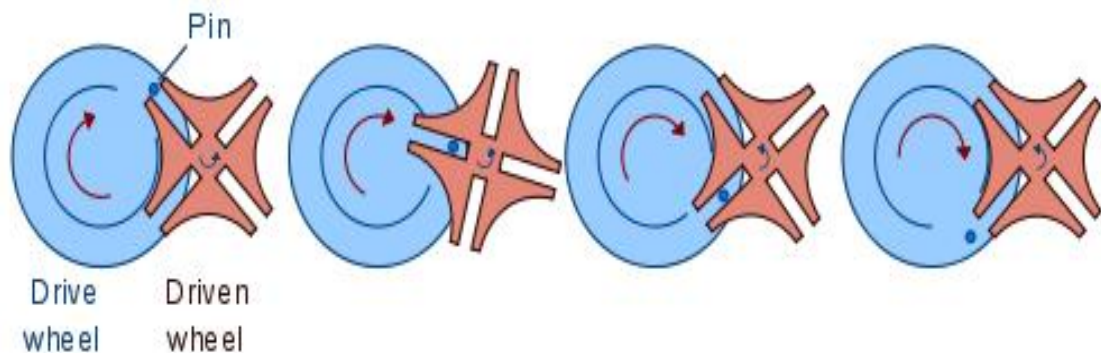


Figure 1.1: Geneva Mechanism

1.2 Problem Statement

- Manual paper cutting methods are time-consuming, less accurate, and require continuous human effort, causing operator fatigue and low productivity.
- Existing automatic paper cutting machines are costly and complex, making them unsuitable for small industries and educational applications.
- There is a need for a low-cost and efficient automatic system that can provide precise paper feeding and uniform cutting with reduced material wastage using a Geneva mechanism.

1.3 Objectives

We have some specific objectives for this project and they are pointed below:

- To design and develop an automatic paper cutting machine using a Geneva mechanism for precise and controlled intermittent motion.
- To achieve accurate and uniform paper cutting with minimum material wastage through synchronized feeding and cutting operations.
- To reduce manual labor and improve operational efficiency by developing a low-cost, reliable, and easy-to-maintain automation system.

1.4 Work Flow Diagram

The above diagram represents the methodology and development process of the “Automatic Paper Cutting Machine Using Geneva Mechanism” project. It shows the step-by-step stages followed to successfully design and fabricate the system.

Study:

In this stage, the working principle of the Geneva mechanism, paper feeding system, and cutting process are studied. Different research papers, machine designs, and automation techniques are analyzed to understand the project requirements.

Design:

The mechanical structure of the machine is designed, including the Geneva wheel, cutting blade arrangement, frame structure, and motor-driven mechanism. Proper dimensions and motion synchronization are planned for accurate paper cutting.

Components Collection:

Required components such as motor, Geneva mechanism parts, cutting blade, rollers, bearings, shafts, frame materials, and power supply components are collected for fabrication.

Assembling:

All mechanical and electrical components are assembled carefully. The motor, Geneva wheel, paper feeding mechanism, and cutting section are connected and aligned properly for smooth operation.

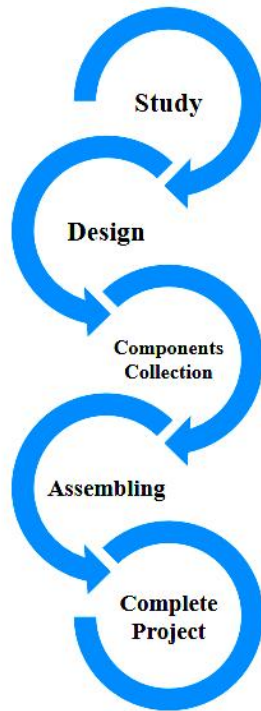


Figure 1.2 : Work Flow Diagram

Complete Project:

After testing and adjustments, the final machine is completed. The system performs automatic paper feeding and precise cutting efficiently with reduced manual effort.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is arranged on Literature Review. Here's a look at some of last year's literature, like our project. By reading them, we can overcome the mistakes of the previous project and make a more effective project.

2.2 History

The history of DIY auto paper cutting machines using the Geneva wheel mechanism is rooted in the development of the Geneva wheel itself and its application in various industries, including printing and paper cutting.

The Geneva wheel, also known as the Maltese cross mechanism, was invented in the 17th century by Swiss watchmaker and engineer, Salomon de Caus. It was initially used in clock making to control the rotational movement of the hand of a clock. The Geneva wheel allowed for precise intermittent movement, making it ideal for applications requiring controlled stops and starts.

Over time, engineers and inventors recognized the potential of the Geneva wheel mechanism in other fields, including the printing and paper cutting industry. The mechanism's ability to provide intermittent rotary motion was leveraged to create automated paper cutting machines.

In the late 19th and early 20th centuries, the concept of DIY auto paper cutting machines using the Geneva wheel mechanism began to emerge. Entrepreneurs and craftsmen devised ways to build their own automated paper cutters, using readily available materials and adapting the Geneva wheel mechanism to suit their specific needs.

As technology advanced, the DIY auto paper cutting machines using the Geneva wheel mechanism evolved. Today, with the rise of the maker and DIY communities, enthusiasts can find various guides, tutorials, and even open-source projects that offer

instructions on building their own automated paper cutting machines using this mechanism.

Overall, the history of DIY auto paper cutting machines using the Geneva wheel mechanism reflects the ingenuity and creativity of individuals harnessing a centuries-old invention to make the paper cutting process more efficient and accessible.

2.3 Literature Survey

The design and analysis of paper cutting machine based on Geneva was analyzed by Vijay et al. [1], they presented a comparison of the position, velocity, acceleration, and jerk between the classical Geneva wheel mechanism and the proposed mechanism. This analysis presents a kinematic study of a mechanism incorporating a Geneva wheel and a gear train to achieve intermittent motion and was declared as a designated analysis and succeeded largely due to its positive economic factors. The design and fabrication of paper cutting machine using Geneva mechanism is useful to cut papers in equal and accurate dimension.

The analysis and synthesis of Geneva mechanism with elliptical crank has been studied by Han Jiguang Yu Kang [2], it has been analyzed that for both internal and external Geneva mechanism, the kinematics coefficient of the Geneva mechanism is a constant if the groove number of the Geneva wheel is a constant. The elliptic crank using as the drive crank of the Geneva wheel is equal to the mechanism which has a variable length and a variable speed along the elliptical moving crank. Therefore the kinematics coefficient of the Geneva mechanism can be changed.

The analysis and modeling of Geneva mechanism was studied by Georgata and Elena [3], the paper presents some aspects theoretical and practical based on the finite element analysis and modeling of Geneva mechanism with four slots, using the CATIA graphic program. This type of mechanism is an example of intermittent gearing that translates a continuous rotation into an intermittent rotary motion. It consists of alternate periods of motion and rest without reversing direction. Also it gives some design parameters with specify a Geneva mechanism will be defined precisely such as number of driving cranks, number of slots, wheel diameter, pin

diameter, etc. Finite element analysis (FEA) can be used for creating a finite element model (preprocessing). The paper focus on the modeling and finite element analysis of Geneva mechanism with four slots. This technique has the ability to change the shape of Geneva mechanism with changing any kinematic properties.

Hrones and Nelson [4], in their paper on Analysis of the Four-Bar Linkage gives review that a 4-bar mechanism is a basic 1-DOF (degree of freedom) mechanism. A 4-bar is created by selecting four link lengths and joining the links with revolute joints to form a loop. A wide variety of paths are possible by arbitrarily choosing a point on the coupler curve. These different curves can be obtained by constructing a physical model of the mechanism and viewing the path of various points without detailed mathematical analysis.

In the Force analysis of the Geneva wheel and face cam in automat, Madhoo et al. [5], driven the automat using single motor for different operations. Here they focus on two main parts they are Geneva wheel and Face cam which are used for their respective operations. Geneva Wheel is used to index the drum which consists of 96 spindles. Due to this Geneva mechanism each of the spindles will hold the ceramic body when the drum is being indexed. Due to which there is a force which is generated in the Geneva wheel is in maximum and minimum position in Cutting mechanism by giving feed through Geneva mechanism.

Kalisindhur et al. [6], designed a mechanism for cutting by giving intermittent feed. This intermittent feed is given by continuous rotation of circular disk in Geneva mechanism. We have designed a belt drive with the help of Geneva mechanism which is used for giving feed and gives smooth operation and smooth movement of the feed at required time interval. The feed from the Geneva drive was cut by using slotted lever mechanism which was designed using slider crank mechanism.

A review on study and analysis of Geneva mechanism design by s. r. durairaju, arunkumar. c, karankumar. r, thiyagarajan. a. they found, according to the need of the user, the design and the specification of the Geneva mechanism could be changed and the required sizes of the wheels could be selected. Lubrication is not necessary. The

high pressure is achieved in this wheel and the crank reduce the fluctuation of pin, so the best output can be achieved. It has been done with 4 slotted geneva mechanism [7].

Automatic Paper Cutting Machine Using Geneva Mechanism by Sunil H V, et.al. The objective of this concept is to design the Geneva mechanism operated paper cutting machine which eliminates the most time taking process of paper marking and helps in feed equal dimension paper in each rotation. This machine is used to reduce the manual work of paper cutting, and also time saving. this machine is very useful for paper manufacturing industry also we can avoid the human errors and also we can use this equipment also in school, colleges, stationary shop's, paper stores, etc. It has been done with 4 slotted geneva mechanism [8].

Design and Analysis of Paper Cutting Machine works on Geneva Mechanism by Vijay Kumar U, Ghanshyam Kumar, Dhareesh Bansod, Deepak Sahu, Aakanksha Suryawanshi rishabh Bendre, kinematic study of a mechanism incorporating a Geneva wheel and a gear train to achieve intermittent motion. Presented is a comparison of the position, velocity, acceleration, and jerk between the classical Geneva wheel mechanism and the proposed mechanism. reducing the extreme jerk of the Geneva wheel. Geneva drive is an indexing Mechanism that converts continues motion to intermittent motion It has been done with 4 slotted geneva mechanism [9].

Design and analysis of geneva mechanism with curved slots by Jung-Fa Hsieh Department of Mechanical Engineering, Far East University, Tainan, The indexing mechanism has been derived utilizing the homogeneous coordinate transformation method and conjugate surface theory. analytical expressions have been derived for the slot profile with and without an offset feature by using 4 slot geneva wheel [10].

Design, Cad Modeling & Fabrication of Geneva Operated Roller Conveyor by Mr M. V. Ingalkar , Mr A. R. Sonekar, Mr Y. D. Bansod, The transport time of the object to cover the entire conveyor 3D modeling of Geneva Operated Roller Conveyor by using CATIA V5 R20 Softwear , design of geneva wheel by using 4 slot geneva mechanism [11].

Cutting Mechanism by Giving Feed through Geneva Mechanism by P.KaliSindhur , Y.karthik, et. Al. Designed a belt drive with the help of Geneva mechanism. The length of the feed can be managed by changing the depth of the slots in Geneva wheel by 4 slot geneve mechanism [12].

To increase the Torque Capacity of a Pneumatic Paper Cutting Machine by AnupamChaturvedi, Hiren Trapasiya, JayeshSevra, Mitkumar Patel, Reduction in operation time is also possible with automation. The existing Pneumatic Crushing Machines take a lot of time for cutting the paper as well as they are very much noisy during their operation. Pneumatic Paper Cutting Machine with an increased Torque Capacity. With the help of this high pressure air willbe able to cut more bunch of paper at one stroke It has been done with 4 slotted geneva mechanism [13].

Intermittent Paper Cutting Mechanism by Giving Feed through Geneva Wheel by Ajay S. Parmar, Amar Singh, Avinash Singh, Avneesh Pandey, Kunal Singh, ManeeshUpadhyay, kinematic study of a mechanism using a Geneva wheel and a gear train to achieve intermittent motion. The feed is given by continuous rotation of circular disk in Geneva mechanism. It has been done with 4 slotted geneva mechanism [14].

Design and Development of Machine to Perform Stamping and Cutting Operation by Rakesh Prajapati ,Purvik Patel, Saurabh Modi,To reduce the time for marking and cutting the papers. Intermittent motion is useful in moving the paper between the cutting periods. It has been done with 4 slotted geneva mechanism [15].

Review on geneva mechanism and its application by ankur prajapati, chinmay patel, Dhwanit pankhania, brijen kanjia, aakash dubey, Geneva drive is also known as Maltese cross mechanism. It converts continuous rotation into an intermittent rotary motion. It has been done with 4 slotted geneva mechanism [16].

2.4 Summary

The above has been discussed in detail in the past few literature's which has given us a lot of motivation to do this project.

CHAPTER 3

MATERIALS AND INSTRUMENT

3.1 Introduction

In this section, we will discuss elaborately about “**Automatic Paper Cutting Machine Using Geneva Mechanism**” and the component description, features, working procedure of our all equipment. The system hardware fabricates composed of micro-controller unit, power unit, source unit, power store unite and many more related components.

3.2 Required Instrument

- SMPS
- Buck Converter
- Gear Box
- Geneva Wheel
- Chain Sprocket
- Bearing

3.3 Switch Mode Power Supply (SMPS)

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power

supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.



Figure 3.1: SMPS

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor. Switched-mode power supplies are classified according to the type of input and output voltages. The four major categories are:

- AC to DC
- DC to DC
- DC to AC
- AC to AC

A basic isolated AC to DC switched-mode power supply consists of:

- Input rectifier and filter
- Inverter consisting of switching devices such as MOSFETs
- Transformer
- Output rectifier and filter
- Feedback and control circuit

The input DC supply from a rectifier or battery is fed to the inverter where it is turned on and off at high frequencies of between 20 KHz and 200 KHz by the switching MOSFET or power transistors. The high-frequency voltage pulses from the inverter are fed to the transformer primary winding, and the secondary AC output is rectified and smoothed to produce the required DC voltages. A feedback circuit monitors the output voltage and instructs the control circuit to adjust the duty cycle to maintain the output at the desired level.

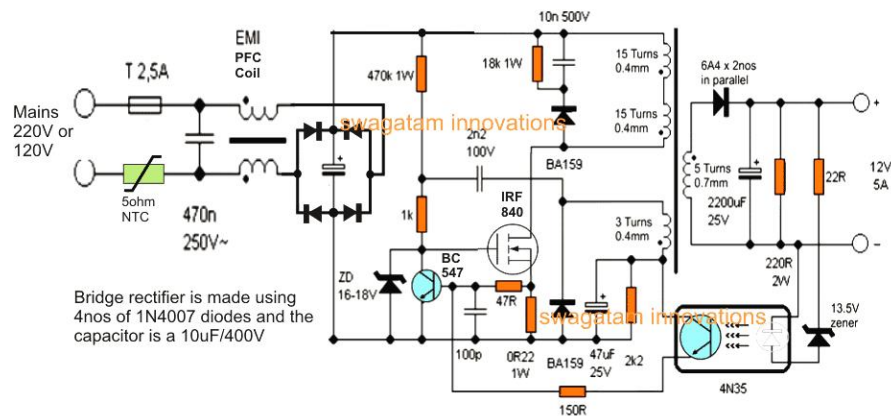


Figure 3.2: SMPS Circuit

Basic working concept of an SMPS

A switching regulator does the regulation in the SMPS. A series switching element turns the current supply to a smoothing capacitor on and off. The voltage on the capacitor controls the time the series element is turned. The continuous switching of the capacitor maintains the voltage at the required level.

Design basics

AC power first passes through fuses and a line filter. Then it is rectified by a full-wave bridge rectifier. The rectified voltage is next applied to the power factor correction (PFC) pre-regulator followed by the downstream DC-DC converter(s). Most computers and small appliances use the International Electrotechnical Commission (IEC) style input connector. As for output connectors and pin outs, except for some industries, such as PC and compact PCI, in general, they are not standardized and are left up to the manufacturer.

There are different circuit configurations known as topologies, each having unique characteristics, advantages and modes of operation, which determines how the input power is transferred to the output. Most of the commonly used topologies such as flyback, push-pull, half bridge and full bridge, consist of a transformer to provide isolation, voltage scaling, and multiple output voltages. The non-isolated configurations do not have a transformer and the power conversion is provided by the inductive energy transfer.

Advantages of switched-mode power supplies

- Higher efficiency of 68% to 90%
- Regulated and reliable outputs regardless of variations in input supply voltage
- Small size and lighter
- Flexible technology
- High power density
- Disadvantages:
- Generates electromagnetic interference
- Complex circuit design
- Expensive compared to linear supplies

Switched-mode power supplies are used to power a wide variety of equipment such as computers, sensitive electronics, battery-operated devices and other equipment requiring high efficiency. Linear voltage IC regulators have been the basis of power supply designs for many years as they are very good at supplying a continuous fixed voltage output. Linear voltage regulators are generally much more efficient and easier to use than equivalent voltage regulator circuits made from discrete components such as a zener diode and a resistor, or transistors and even op-amps. The most popular linear and fixed output voltage regulator types are by far the 78... positive output voltage series, and the 79... negative output voltage series.

These two types of complementary voltage regulators produce a precise and stable voltage output ranging from about 5 volts up to about 24 volts for use in many electronic circuits. There is a wide range of these three-terminal fixed voltage regulators available each with its own built-in voltage regulation and current limiting circuits. This allows us to create a whole host of different power supply rails and

outputs, either single or dual supply, suitable for most electronic circuits and applications. There are even variable voltage linear regulators available as well providing an output voltage which is continually variable from just above zero to a few volts below its maximum voltage output.

Switch Mode Power Supply

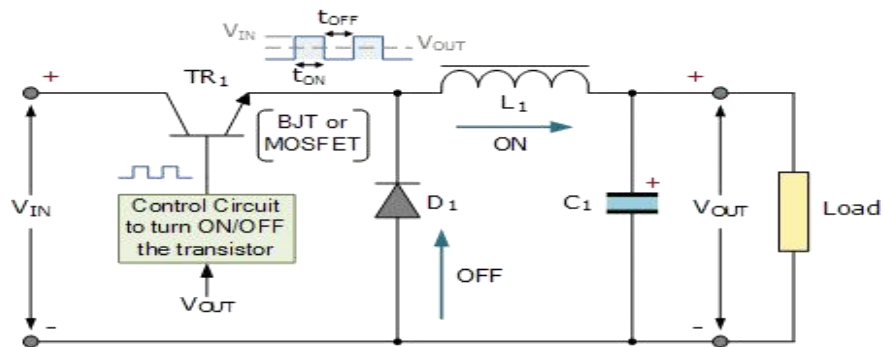


Figure 3.3: SMPS Circuit Connection

Most d.c. power supplies comprise of a large and heavy step-down mains transformer, diode rectification, either full-wave or half-wave, a filter circuit to remove any ripple content from the rectified d.c. producing a suitably smooth d.c. voltage, and some form of voltage regulator or stabiliser circuit, either linear or switching to ensure the correct regulation of the power supplies output voltage under varying load conditions. Then a typical d.c. power supply would look something like this:

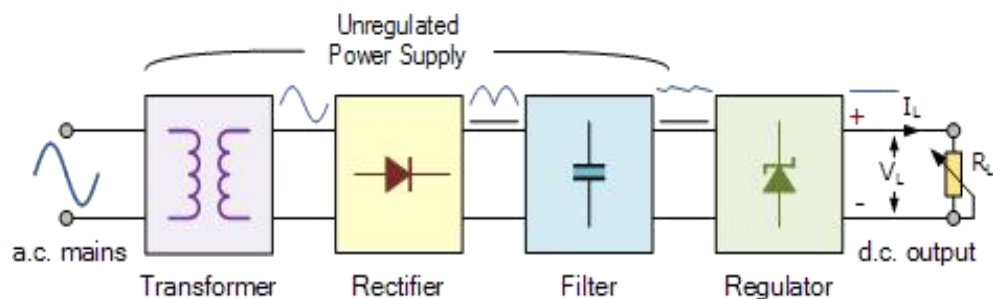


Figure 3.4: DC Power supply way

These typical power supply designs contain a large mains transformer (which also provides isolation between the input and output) and a dissipative series regulator circuit. The regulator circuit could consist of a single zener diode or a three-terminal

linear series regulator to produce the required output voltage. The advantage of a linear regulator is that the power supply circuit only needs an input capacitor, output capacitor and some feedback resistors to set the output voltage.

3.4 Buck Converter

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter). It is called a buck converter because the voltage across the inductor “bucks” or opposes the supply voltage.



Figure 3.5: DC -DC Buck Converter

DC-DC Buck Converter Step Down Module LM2596 Power Supply is a step-down(buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. The LM2596 series operates at a switching frequency of 150kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators.

Specifications of DC-DC Buck Converter Step Down Module LM2596 Power Supply

- Conversion efficiency: 92% (highest)
- Switching frequency: 150KHz
- Output ripple: 30mA9maximum)
- Load Regulation: $\pm 0.5\%$
- Voltage Regulation: $\pm 0.5\%$
- Dynamic Response speed: 5% 200uS
- Input voltage:4.75-35V
- Output voltage:1.25-26V(Adjustable)
- Output current: Rated current is 2A, maximum 3A (Additional heat sink is required)
- Conversion Efficiency: Up to 92% (output voltage higher, the higher the efficiency)
- Switching Frequency: 150KHz
- Rectifier: Non-Synchronous Rectification
- Module Properties: Non-isolated step-down module (buck)
- Short Circuit Protection: Current limiting, since the recovery
- Operating Temperature: Industrial grade (-40 to +85) (output power 10W or less)

3.5 Gear Box

The Gear Box is a high-torque brushed DC motor combined with a metal gearbox to reduce speed and increase torque. This motor is widely used in robotics, conveyor systems, automatic machines, electric vehicles, DIY projects, drilling machines, and industrial automation applications. The gearbox allows the motor to run at low RPM while delivering powerful rotational force for heavy-load operations. It supports both 12V and 24V DC supply depending on the model and gear ratio.



Figure 3.6: Gear Box

Specification

- Motor Type: 775 Brushed DC Gear Motor
- Operating Voltage: 12V DC / 24V DC
- Speed Range: 5 RPM – 500 RPM (depends on gearbox ratio)
- Torque: High Torque Output
- Shaft Diameter: 8mm
- Gearbox Type: Metal Spur
- Current Consumption: 1A – 10A

3.6 Bearing

A bearing is a mechanical component designed to reduce friction and support the smooth movement of rotating or sliding parts in machinery. By minimizing resistance between surfaces, bearings enhance efficiency and extend the lifespan of equipment. They come in various types, including ball bearings, roller bearings, and plain bearings, each tailored to specific load and motion requirements. Bearings are essential in applications ranging from automotive and industrial machinery to household appliances and aerospace systems. Made from durable materials like steel or ceramics, they ensure reliability, precision, and stability in dynamic environments, enabling machines to operate efficiently under various conditions.



Figure 3.7: Bearing

Specification

- **Type:** Ball, Roller, Needle, or Plain Bearing.
- **Material:** Steel (Chrome/Stainless), Ceramic, or Composite.
- **Load Capacity:** Dynamic (C) and Static (C₀) ratings.
- **Dimensions:** Bore Diameter (ID), Outer Diameter (OD), and Width.
- **Speed:** Maximum RPM limit.
- **Lubrication:** Greased, oil-lubricated, or sealed.
- **Sealing:** Open, shielded, or sealed design.

3.7 Geneva Wheel

The Geneva Wheel, also known as the Geneva Mechanism or Maltese Cross Mechanism, is a mechanical device used to convert continuous rotational motion into intermittent (step-by-step) rotary motion. In this mechanism, a driving wheel with a pin rotates continuously and engages with the slots of a star-shaped wheel (Geneva wheel). When the pin enters a slot, it forces the Geneva wheel to rotate by a fixed angle (for example, 90° for a 4-slot wheel). After completing the movement, the driver continues rotating but the Geneva wheel remains stationary (dwell period) until the next engagement. Between each step, a locking surface prevents unwanted movement, ensuring accurate positioning and smooth indexing.



Figure 3.8: Geneva Wheel

Features

- Converts continuous motion into intermittent step motion
- Provides accurate positioning and indexing
- Has a dwell period (rest time) between movements
- Common slot counts: 4, 6, 8, etc. (determines rotation angle per step)

3.8 Chain Sprocket

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system. Another type of drive chain is the Morse chain, invented by the Morse Chain Company of Ithaca, New York, United States. This has inverted teeth. Sometimes the power is output by simply rotating the chain, which can be used to lift or drag objects. In other situations, a second gear is placed and the power is recovered by attaching shafts or hubs to this gear.

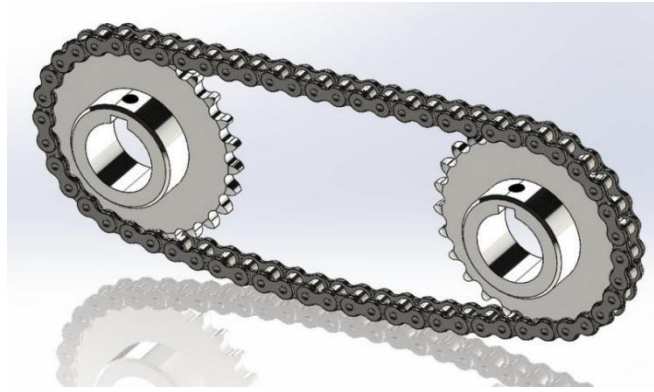


Figure 3.9: Chain Sprocket

Though drive chains are often simple oval loops, they can also go around corners by placing more than two gears along the chain; gears that do not put power into the system or transmit it out are generally known as idler-wheels. By varying the diameter of the input and output gears with respect to each other, the gear ratio can be altered. For example, when the bicycle pedals' gear rotate once, it causes the gear that drives the wheels to rotate more than one revolution. Duplex chains are another type of chain which are essentially two chains joined side by side which allow for more power and torque to be transmitted.

CHAPTER 4

METHODOLOGY

4.1 Our methodologies for the project

Our methodologies for the project:

- Design the mechanical structure of the automatic paper cutting machine using the Geneva mechanism for intermittent paper feeding and accurate cutting operation.
- Connect the motor, Geneva wheel, rollers, and cutting blade system to ensure synchronized movement between paper feeding and cutting processes.
- Feed the paper through the roller mechanism, where the Geneva mechanism controls step-by-step movement for equal-length paper positioning.
- Perform automatic cutting using the blade mechanism after each fixed paper movement and analyze the cutting accuracy, speed, and overall machine performance.

4.2 Overview our Project

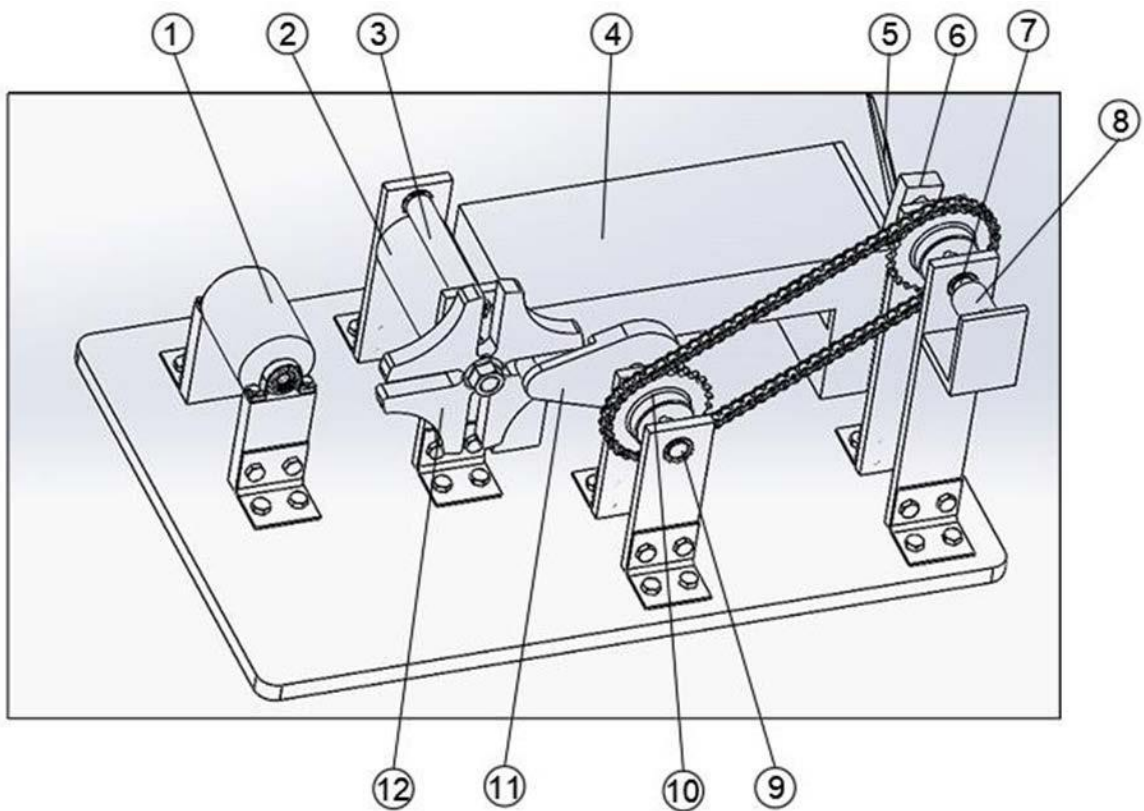


Figure 4.1 : Overview of the paper Cutting machine

1. Paper Roll
2. Roller
3. Support Roller
4. Support plate
5. Cutter
6. Support Frame
7. Bearing
8. Gear motor
9. Bearing Shaft
10. Chain Sprocket
11. Pin
12. Geneva Wheel

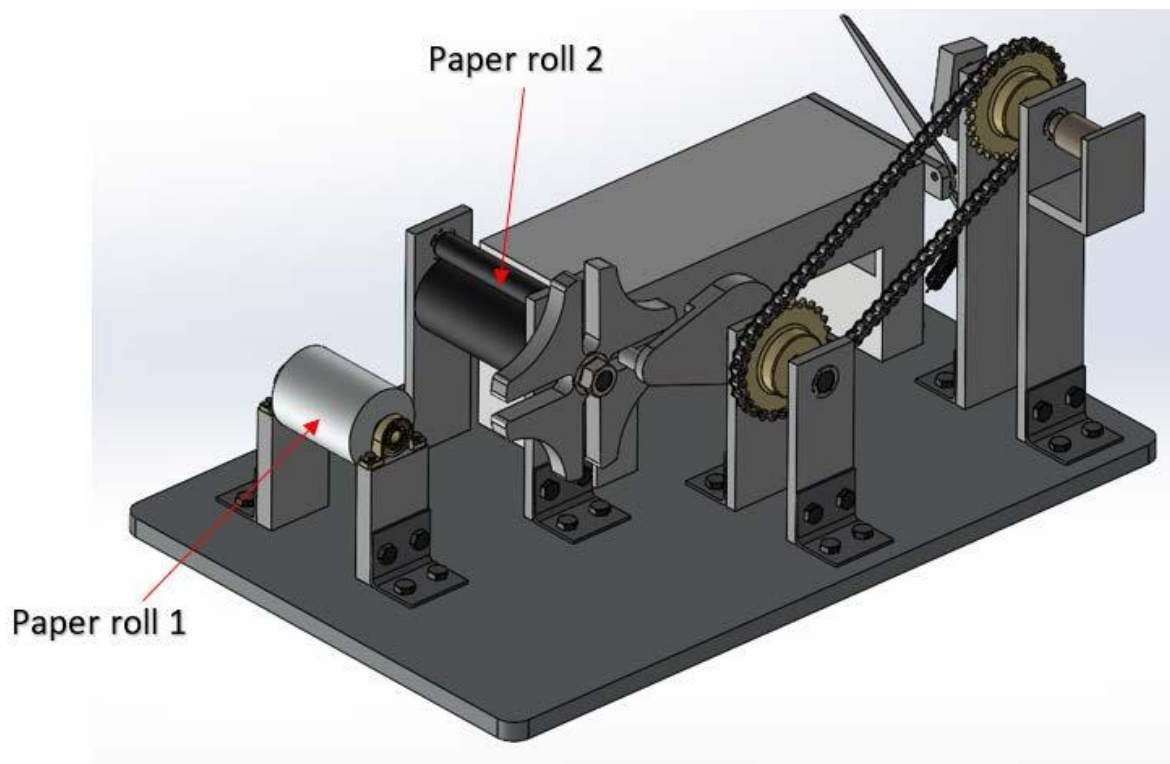


Figure 4.2 : 3D View Our Project

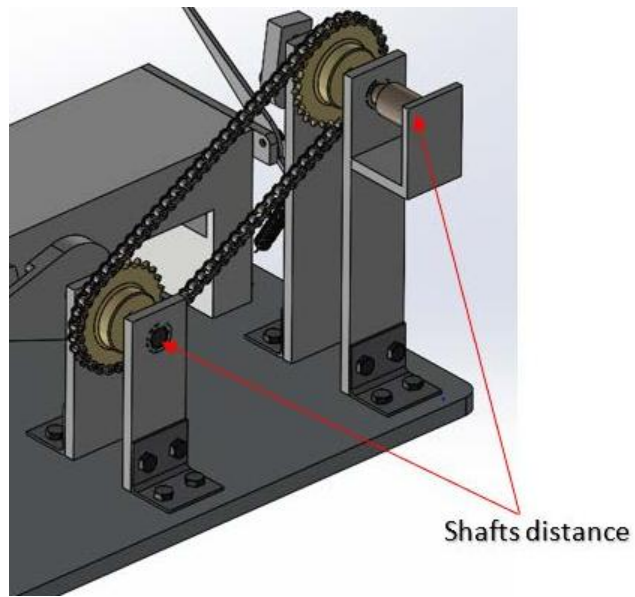


Figure 4.3 : 3D View Shaft Distance

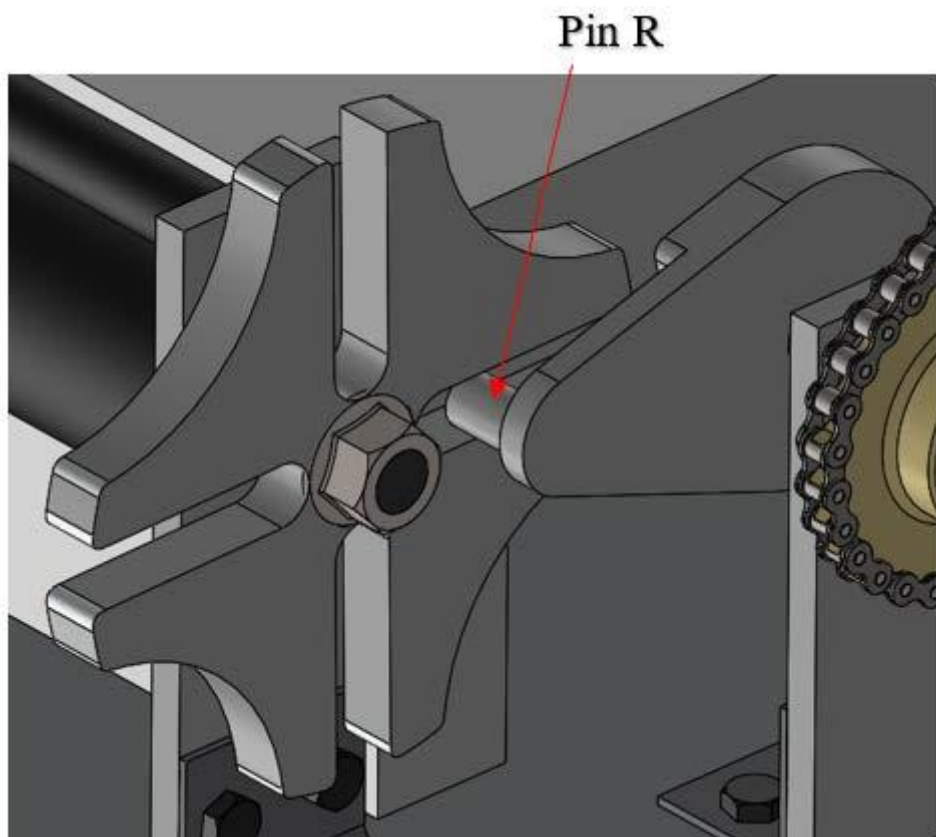


Figure 4.4 : 3D View Geneva Mechanism

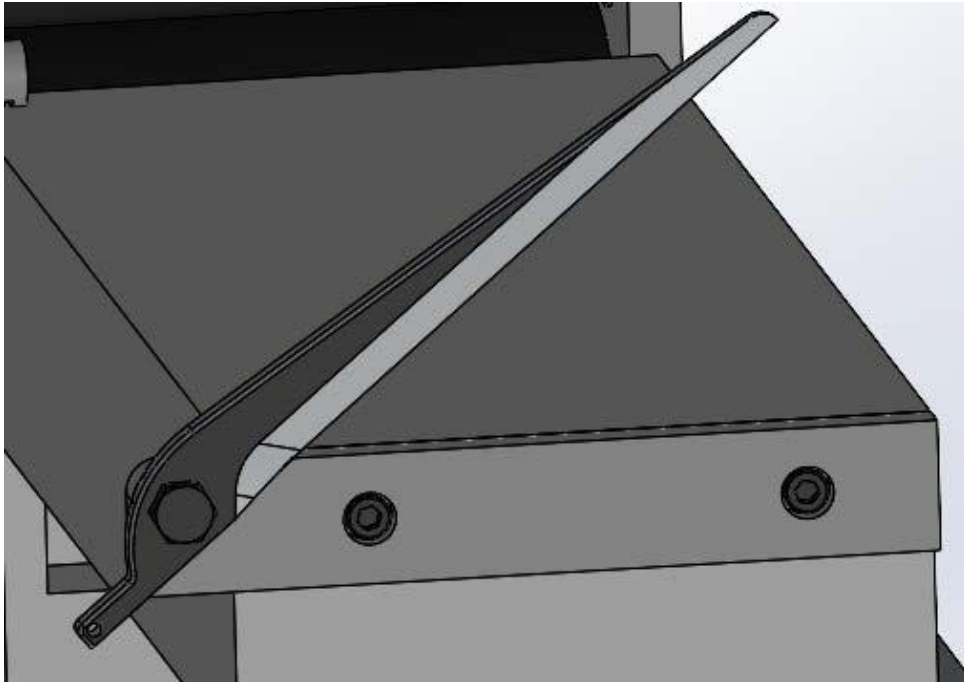


Figure 4.5 : 3D View Cutting blade

4.3 Block Diagram

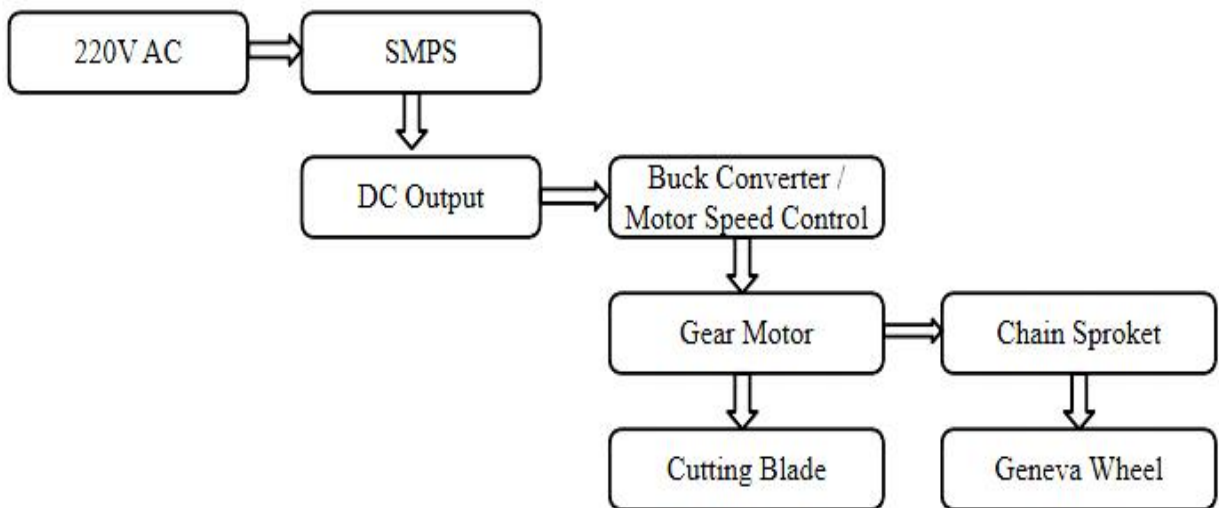


Figure 4.6: Block Diagram of Our project

4.4 Working Principle

- The SMPS (Switched Mode Power Supply) supplies regulated DC power to the complete automatic paper cutting machine for stable operation of all components.
- The gear motor rotates continuously and provides the main driving force to the Geneva mechanism through the chain and sprocket arrangement.
- The buck converter controls and reduces the voltage supplied to the gear motor, allowing adjustment of motor speed according to the required paper feeding and cutting operation.
- The Geneva mechanism converts the continuous rotary motion of the gear motor into intermittent motion, which moves the paper forward step-by-step with accurate positioning.
- After each fixed paper movement, the cutting blade performs the cutting operation automatically, ensuring equal paper size and precise cutting accuracy.
- The synchronized operation of the gear motor, speed control system, and Geneva mechanism increases efficiency, reduces manual effort, and provides smooth automatic paper cutting performance.

4.5 Experimental Setup of Our System



Figure 4.7: Our System Structural Frame Setup



Figure 4.8: Our System Wiring Implementation

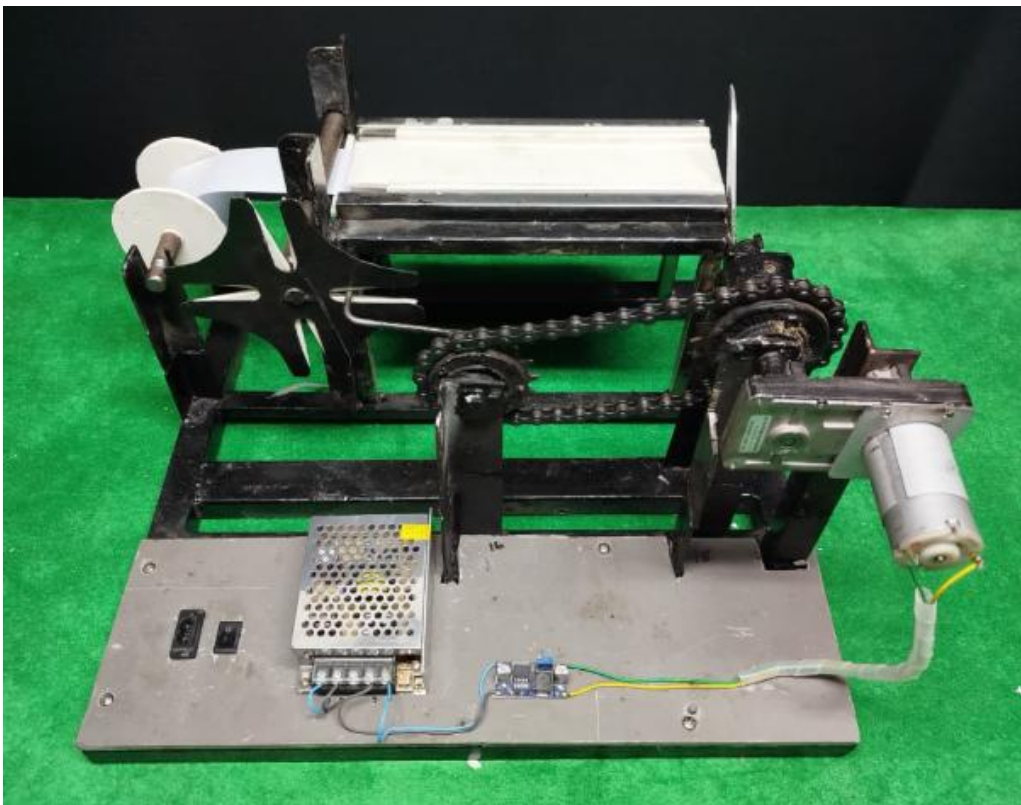


Figure 4.9: Final Prototype

CHAPTER 5

RESULT ANALYSIS

5.1 Project outcome

After finally completing this project, we ran it & we observed the output of this project. We can see that it is working well as expected. After making our project we observe it very careful. It works as we desire. Our project give output perfectly and all equipment are work perfectly. We check how much it works and we get perfect output from this project.

- The machine successfully converts continuous motor rotation into intermittent motion using the Geneva mechanism, ensuring precise step-by-step paper feeding.
- The cutting accuracy is high because each paper movement is fixed and synchronized with the cutting blade operation.
- Speed control using the buck converter allows smooth adjustment of the gear motor, improving overall performance and flexibility.
- The system reduces manual labor significantly and increases productivity compared to traditional manual paper cutting methods.
- Paper wastage is minimized due to accurate alignment and uniform cutting length.
- The overall system operates smoothly with good mechanical synchronization between motor, transmission system, and cutting unit, making it reliable for continuous use.

Data Calculation

Collect data

- Motor speed (N1) : 60
- r.p.m Driving sprocket teeth (T1) : 18
- Driven sprocket teeth (T2) : 18
- Roller diameter (D) : 16 mm = 0.016 m
- Geneva wheel slots (Z) : 4
- Motor voltage (V) : 12V
- Motor current (I) : 0.4

Motor Data Calculation

The power is calculated using the formula $P = V \times I$

$$P = 12V \times 0.4A$$

$$P = 4.8 \text{ W}$$

Result: Motor Power = 4.8 W

Sprocket Speed Ratio

The speed of the driven sprocket is calculated using the teeth ratio:

$$N_2 = N_1 \times (T_1 / T_2)$$

$$N_2 = 60 \times (18 / 18)$$

$$N_2 = 60 \text{ r.p.m}$$

Result: $N_2 = 60 \text{ r.p.m}$

Cutting Speed Calculation

The cutting speed (V) is calculated as follows:

$$V = (\pi \times D \times N) / 60$$

$$V = (\pi \times 0.016 \times 60) / 60$$

$$V = 0.0503 \text{ m/s}$$

$$\begin{aligned} \text{Cutting Speed} &= 0.0503 \text{ m/s} \\ &= (0.0503 \times 60 \times 60) \text{ m/h} \\ &= 181.08 \text{ m/h} \end{aligned}$$

Step Angle Calculation

The step angle (θ) for the Geneva wheel is determined by the number of slots (Z):

$$\theta = 360^\circ / Z$$

$$\theta = 360^\circ / 4$$

$$\theta = 90^\circ$$

Result: Step Angle = 90°

5.2 Advantages

- Automatic operation reduces human effort.
- High cutting precision and repeatability.
- Easy speed control using buck converter.
- Simple and reliable Geneva mechanism.
- Reduces paper wastage and errors.
- Suitable for continuous industrial operation.
- Low power consumption and maintenance cost.

5.3 Application

- Used in printing and publishing industries for paper cutting.
- Applied in packaging industries for sheet preparation.
- Suitable for notebook and paper product manufacturing.
- Used in small-scale automatic cutting workshops.
- Helpful in educational and mechanical engineering laboratories.
- Applicable in label and card cutting operations.

5.4 Limitation

- Suitable mainly for thin and medium-thickness paper.
- Cutting speed is limited by the Geneva mechanism motion.
- Not suitable for very large industrial-scale production.
- Limited cutting area depending on machine frame size.
- Paper width is restricted by roller and blade dimensions.

5.5 Discussion

The compact double pipe heat exchanger demonstrates an efficient and low-cost method of heat transfer using simple construction. Heat exchange between hot and cold fluids occurs effectively through concentric pipes, with better performance observed in counter flow conditions. The use of locally available materials makes the system economical and easy to build. Some minor heat losses and leakage may affect performance. Overall, the project provides clear practical understanding of heat transfer and is suitable for educational and small-scale applications.

The Automatic Paper Cutting Machine Using Geneva Mechanism is an efficient and low-cost automation system designed for accurate paper cutting operations. The Geneva mechanism provides intermittent motion, which helps maintain equal paper feeding distance and improves cutting precision. The use of a gear motor, SMPS, and buck converter ensures stable operation and adjustable speed control. This project reduces manual labor, saves time, and minimizes paper wastage compared to traditional cutting methods. The machine is suitable for small industries, workshops, and educational purposes. However, it has limitations in handling thick or large paper sheets and requires regular maintenance for smooth mechanical performance.

CHAPTER 6

CONCLUSION

6.1 Conclusion

The “Automatic Paper Cutting Machine Using Geneva Mechanism” is a useful and efficient automation project designed to improve the paper cutting process with better accuracy and reduced manual effort. The project successfully demonstrates the practical use of the Geneva mechanism, which converts continuous rotational motion into controlled intermittent motion for precise paper feeding. The integration of components such as SMPS, gear motor, and buck converter ensures stable power supply, smooth operation, and adjustable speed control according to operational requirements.

This system provides uniform paper cutting, minimizes paper wastage, and increases productivity compared to manual cutting methods. The machine is simple in construction, cost-effective, and easy to maintain, making it suitable for small industries, workshops, printing sectors, and educational laboratories. The project also highlights the importance of mechanical automation in industrial applications where repetitive operations are required. Although the system has some limitations, such as handling thick paper stacks and limited cutting size, the overall performance of the machine is reliable and efficient. Therefore, this project can be considered a successful implementation of an automatic paper cutting system using the Geneva mechanism.

6.2 Future Scope

The model can be improved by making some changes in the program and components. Some suggestions are given below.

- Can be upgraded with microcontroller-based automation system.
- Automatic sensor-based paper alignment can be added for higher accuracy such a IR Sensor .
- Conveyor system integration can support continuous large-scale production.
- IoT monitoring system can be added for remote control and performance tracking.
- High-power motor and Blade can be used for cutting thicker paper materials.

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