Indian Institute of Technology Gandhinagar

Geneva Wheel Mechanism

ME 352 Experiment Report

EXPERIMENT 8

Group 6

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Under the guidance of

Prof. Jayaprakash KR

Objective:

Designing a Geneva wheel mechanism and implementing a physical model which rotates the indexing wheel with six steps and an index and dwell time of 10s and 20s respectively.

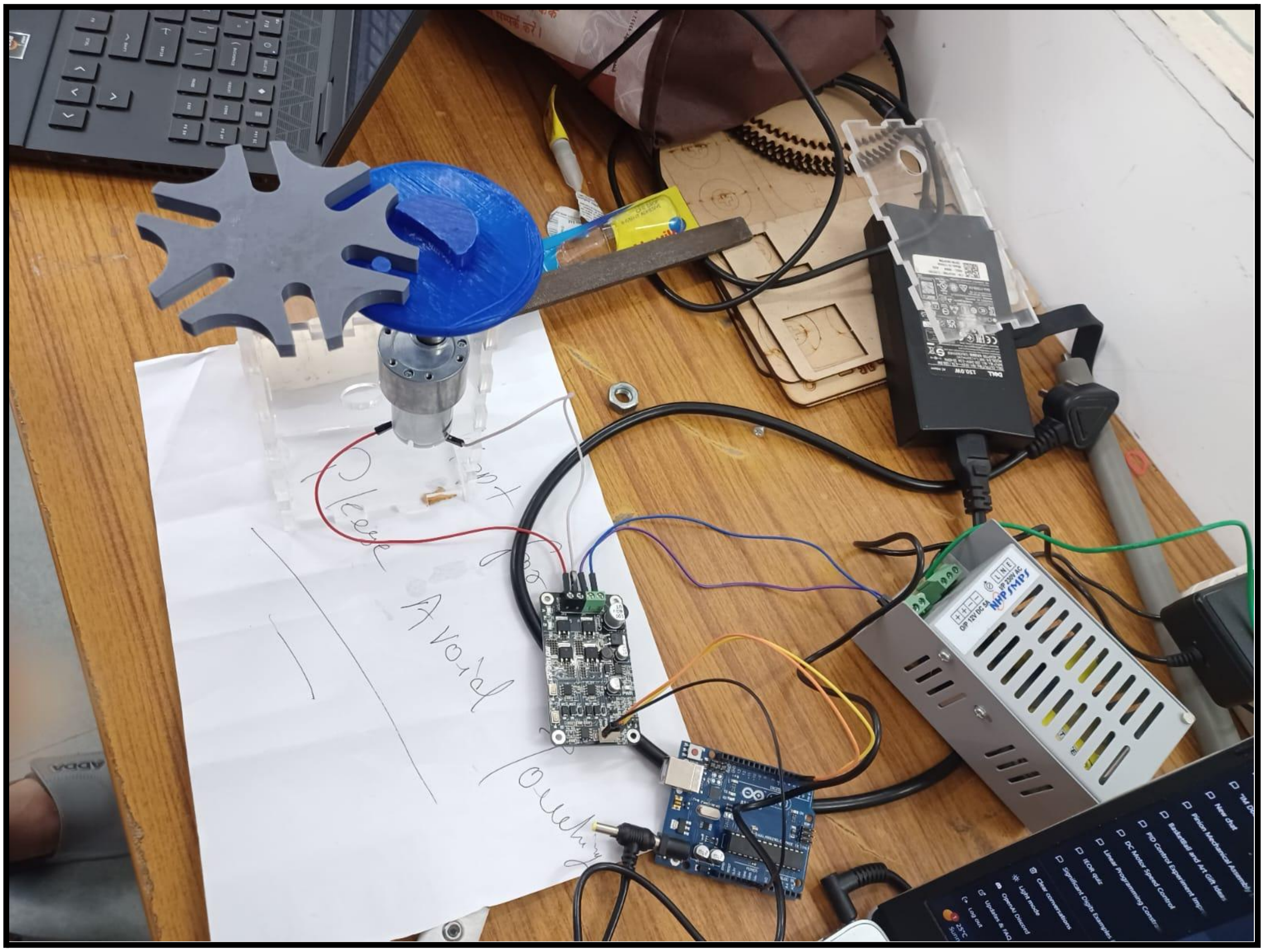


Fig: The set up and electrical connections

Introduction

Geneva mechanism, also called Geneva Stop, is one of the most commonly used devices for producing intermittent rotary motion, characterized by alternate periods of motion and rest with no reversal in direction. It is also used for indexing (i.e., rotating a shaft through a prescribed angle).

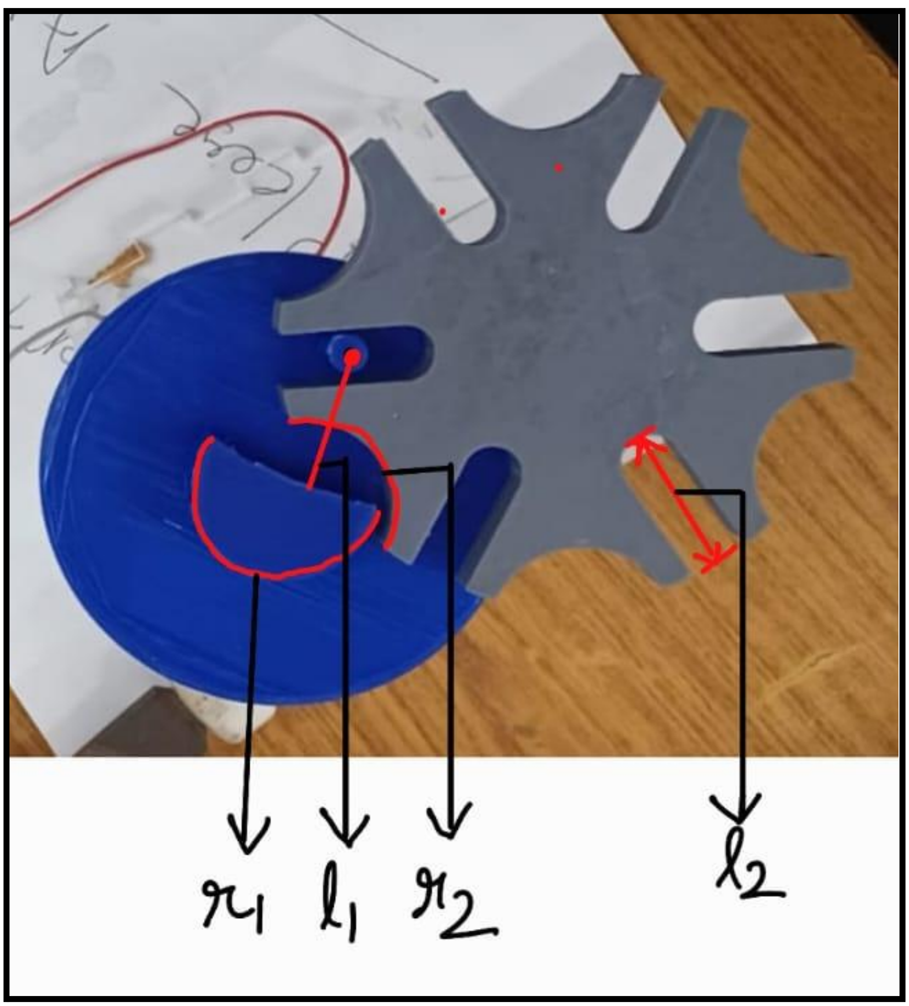
Index time: The index time is the duration for which the driving pin of the geneva wheel is engaged with the driven disc, causing it to rotate.

Dwell time: The dwell time is the period of pause between two successive rotations of the driven disc, during which the driving pin is disengaged from the driven disc. The dwell time allows the driven disc to reset to its starting position and reduces the mechanical stress on the mechanism.

Experimental Design

We were required to make a physical model of the Geneva wheel mechanism, which enables a driver to rotate the wheel attached to it fully in 6 steps. The dwell time, the time the driven wheel remains stationary, was given to be 20 s, and the index time, the time for a whole rotation of the driven wheel, was set to 10 s. Then appropriate calculations were done and a model to implement this was designed to be fabricated. The driver wheel is driven by a dc motor whose power is controlled by an external Arduino Uno.

Design Logistics:



To make the both wheels compatible with each other, dimensions need to be decided carefully. We started with the two constraints:

1. r1 = r2
2. l1 = l2

Fabrication

1. Main wheel (Geneva wheel)

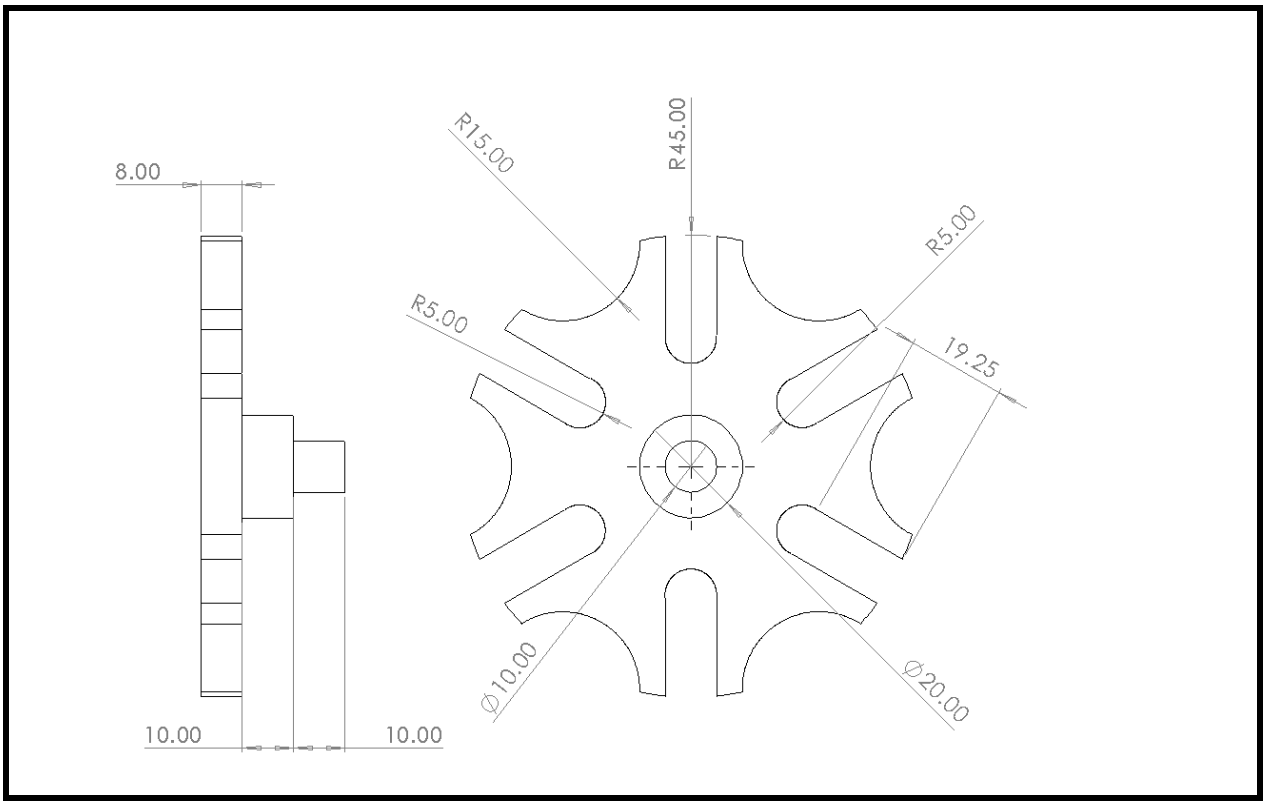


Fig: The orthographic projections of geneva wheel

Fig: The geneva wheel with 6 steps

2. Driver wheel

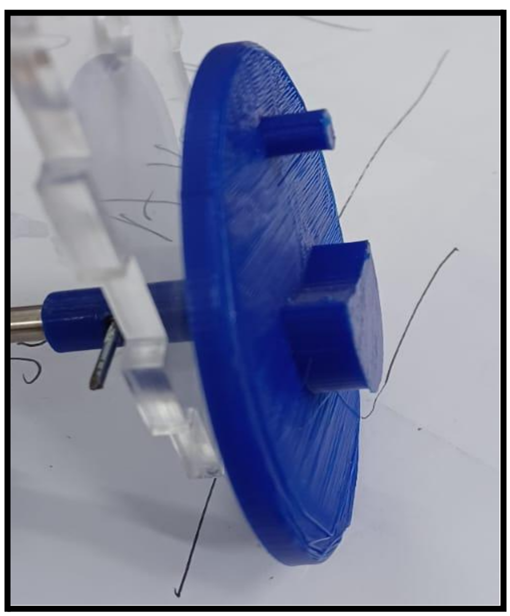


Fig: The driver wheel

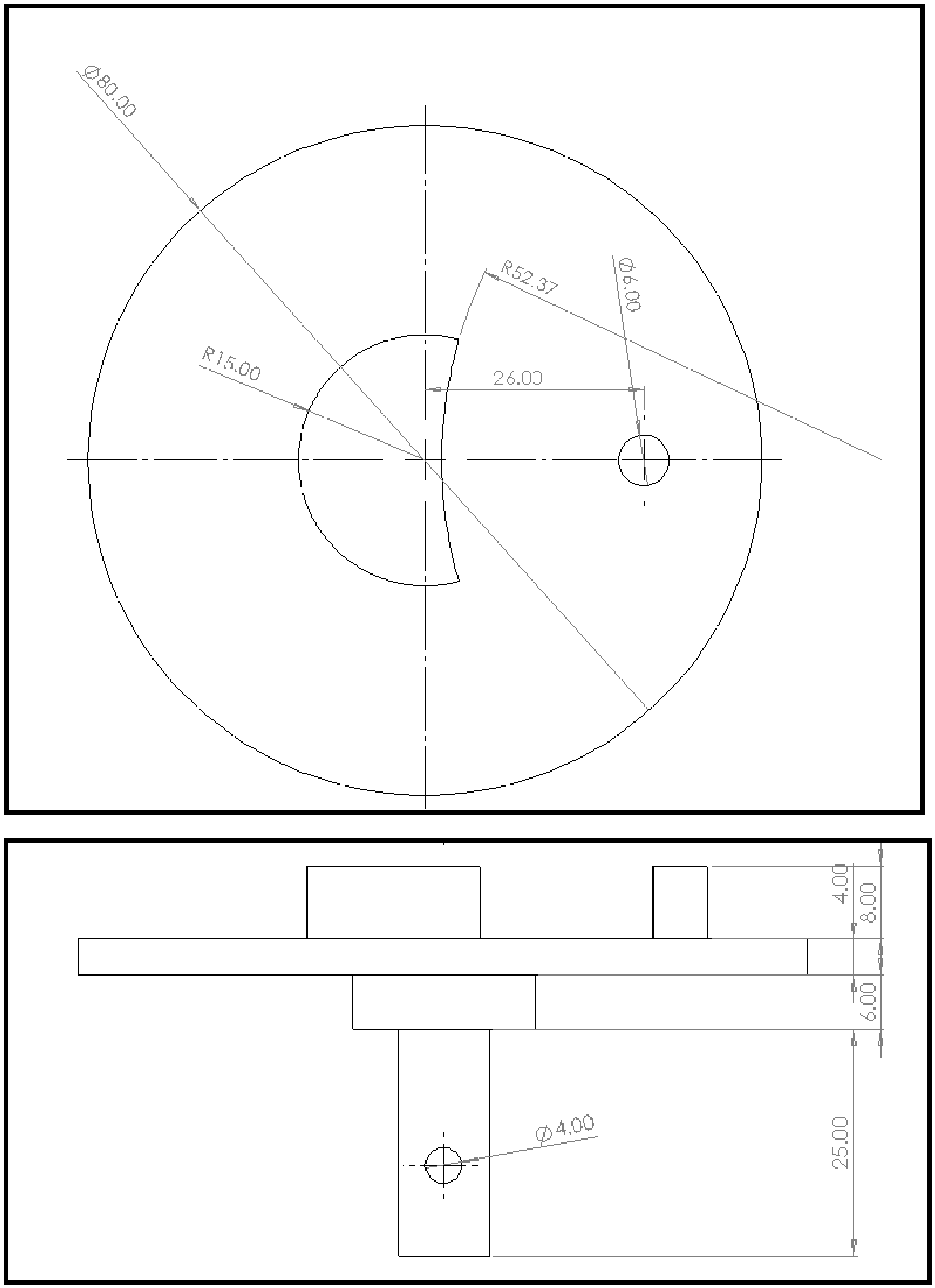


Fig: Orthographic projections of the driver wheel

3. Casing:

Fig: The housing

The two wheels for the mechanism were designed in Autodesk Inventor and were fabricated using 3d printing.
The housing or casing for the setup was cut out of acrylic sheet using laser cut. The casing was then friction fitted.

Mathematical Calculations

The dwell period and index period are affected by the angle between slots and the rotation speed of the driver as per the below equations:

$$T_i = \frac{(180 - \frac{360}{n})}{360 * N}$$

$$T_d = \frac{(180 + \frac{360}{n})}{360 * N}$$

Here n is no of slots in the driven wheel
N is rpm of driver
T_i and T_d are index and dwell period in minutes

Given:

$T_i = \frac{1}{6} min$

$T_d = \frac{1}{3} min$

Equations become

$\frac{1}{3}N + \frac{2}{n} = 1$

$\frac{2}{3}N - \frac{2}{n} = 1$

Solving we get :

n=6 divisions

N=2 rpm

We will have to set our motor rpm to 2 by using the PWM function available in the Arduino.

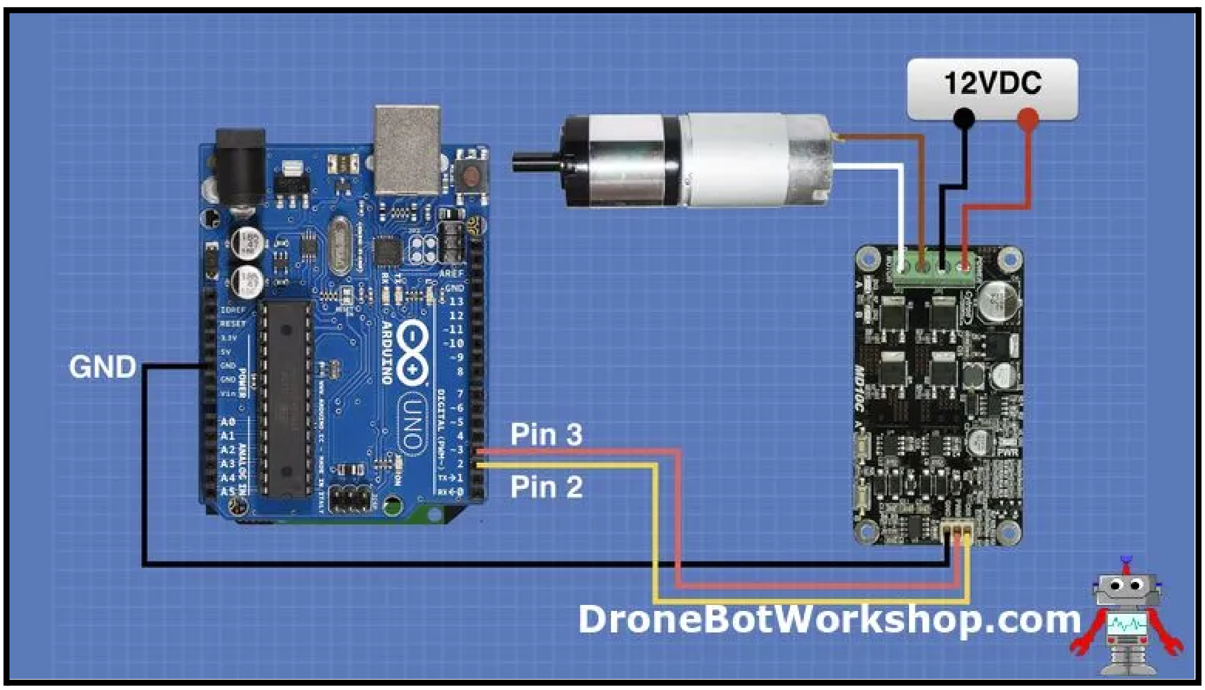


Fig: The electrical connections

Arduino Code to run the motor using the driver:

// Defining Pin

// Pulse Width Modulation (PWM) is a technique which takes a
constant steady state DC voltage and produces a train of fixed amplitude
ON/OFF pulses whose average DC value is determined by the width or duration of the pulses
given by the duty cycle.

// PWM is connected to pin 3.

```
const int pinPwm = 3;
//DIR PIN
//Direction input receives either high or low digital signal that regulates direction of rotation
// DIR is connected to pin 2.
const int pinDir = 2;
// The setup routine runs once when you press reset.
void setup() {
// Initialize the PWM and DIR pins as outputs.
pinMode(pinPwm, OUTPUT);
pinMode(pinDir, OUTPUT);
}
// The loop routine runs over and over again forever.
void loop() {
analogWrite(pinPwm, 51);
}
```

Possible Errors and reason:

There may be some discrepancies in dimensions of the steps of the geneva wheel.
The surface of the model may not be friction-free and hence may cause some hold up while rotating.
Geneva mechanism, in general, when used for a long time, is prone to have a lot of wear and tear due to the sudden jerking movement it usually has and hence is kept oiled to the maximum extent.
Inaccurate timing or synchronization of motor and geneva wheel.
Misalignment of motor shaft and geneva wheel.
Inconsistent supply voltage.

Conclusions:

The geneva wheel completed one revolution in an average of 60 ± 0.5 seconds given the required dwell time and the index time. [Three iterations were made, i.e. the system was powered three times].

The objective of the experiment was to determine the performance of a Geneva wheel mechanism, driven by a DC motor, and to understand the concept of index time and dwell time. The experiment was carried out using a Geneva wheel and a driver wheel powered by a DC motor. The speed of the motor was controlled, and the rotation of the Geneva wheel was observed and recorded.

The results of the experiment showed that the Geneva wheel rotates at a constant speed and the index time and dwell time can be accurately determined. The experiment demonstrated the functioning of the Geneva wheel mechanism and the principles of index time and dwell time. The results were found to be in agreement with the theoretical predictions.

In conclusion, the Geneva wheel experiment was a successful demonstration of the principles of index time and dwell time in a Geneva wheel mechanism. The experiment provided valuable insight into the functioning of the mechanism and helped to reinforce the understanding of the principles involved.

Future Scopes:

The future scope of Geneva wheel mechanism could include the following areas:

Automation: The Geneva wheel mechanism could be integrated into automated systems and machinery to provide precise and smooth movement.
Robotics: Geneva wheel mechanism could be used as a component in robotics systems to achieve smooth and precise movement.
Medical equipment: Geneva wheel mechanism could be used in medical equipment to provide precise and smooth movement, such as in patient handling devices.
Consumer goods: The Geneva wheel mechanism could be used in consumer goods such as clocks and other devices that require precise and smooth movement.
Automotive: The Geneva wheel mechanism could be used in automotive applications, such as for smooth gear shifting in transmissions.

Limitations:

We couldn't get reading by using a magnetic encoder and hence measured the rpm of the geneva wheel using a manual method.

Acknowledgements:

We would like to express our sincerest gratitude to Mr. Jayprakash KR, Assistant Professor of Mechanical Engineering at IIT Gandhinagar, for his invaluable guidance and support throughout the completion of our experiment on Design and implementation of the Geneva wheel mechanism. We also extend our appreciation to our TAs NagaVishnu,
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- Geneva Mechanism Animation - YouTube
- Geneva Wheel Mechanism | Engineers Gallery