

# Design and Implementation of A Gravity Battery System - Solar Powered Gravitational Potential Energy Storage Prototype

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**Abstract:** *The increasing demand for renewable energy has created the need for efficient and sustainable energy storage systems. Conventional lithium-ion batteries have limitations such as high cost, chemical degradation, environmental pollution, and safety risks. This research paper presents the design and implementation of a gravity battery system that stores energy in the form of gravitational potential energy.*

**Keywords:** *renewable energy*

## I. INTRODUCTION

The rapid growth of renewable energy sources such as solar and wind power has introduced challenges related to energy storage and supply-demand balancing.

## II. SYSTEM DIAGRAMS

The following figures illustrate the complete gravity battery system including charging and discharging operations, CAD model, and performance analysis.

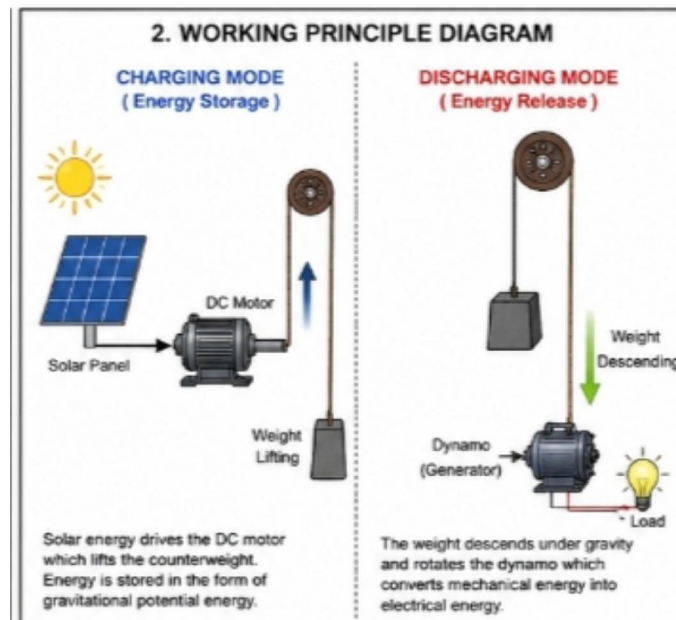


Figure 1: Working Principle of Gravity Battery System



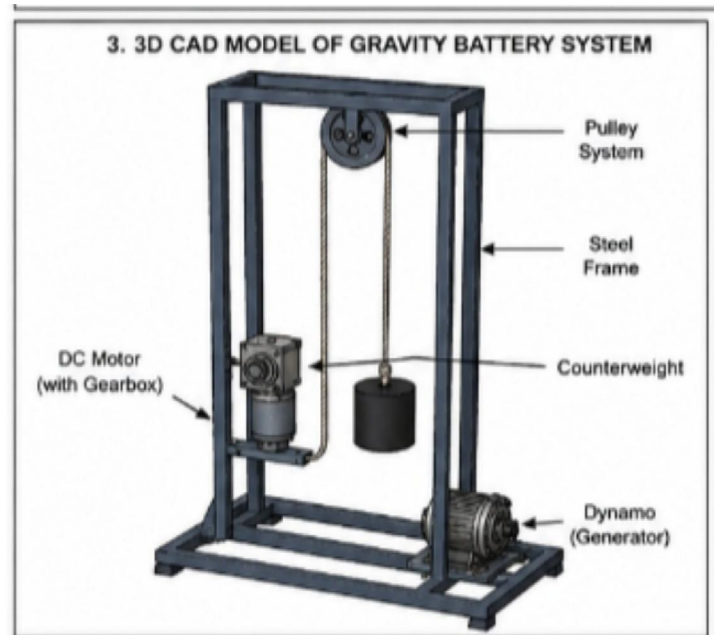


Figure 2: 3D CAD Model of Gravity Battery Prototype

### III. PROBLEM STATEMENT

Renewable energy sources are unable to provide continuous electricity due to fluctuations in generation. Conventional batteries used for storage are expensive and environmentally harmful.

### IV. OBJECTIVES

- To design and fabricate a compact gravity battery prototype.
- To store energy using gravitational potential energy.
- To utilize solar energy for charging operation.
- To study the charging and discharging characteristics of the system.

### V. LITERATURE REVIEW

Several researchers have studied gravity energy storage systems for renewable integration.

### VI. METHODOLOGY

A compact gravity battery prototype was designed using a steel frame, pulley system, counterweight, DC motor, and electric dynamo.

### VII. WORKING PRINCIPLE

The gravity battery works on the principle of gravitational potential energy.

$$PE = m \times g \times h$$

### VIII. COMPONENTS USED

- Solar Panel
- DC Motor
- Gear Reduction Box

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DOI: 10.48175/IJARSCT-35625



- Pulley System
- Counterweight
- Electric Dynamo
- Steel Frame

### IX. BILL OF MATERIALS

Total Cost = ₹6750

### X. MANUFACTURING PROCESS

Cutting, welding, grinding, and drilling operations were performed.

### XI. ELECTRICAL CONNECTIONS

The electrical system consists of solar panel wiring, motor connections, switches, and generator output circuits.

### XII. CALCULATIONS

Mass of counterweight = 35 kg

Height = 1.5 m

$g = 9.81 \text{ m/s}^2$

$PE = 35 \times 9.81 \times 1.5$

$PE = 514.8 \text{ Joules}$

### XIII. RESULTS AND DISCUSSION

The system successfully powered LED loads during discharging operation.

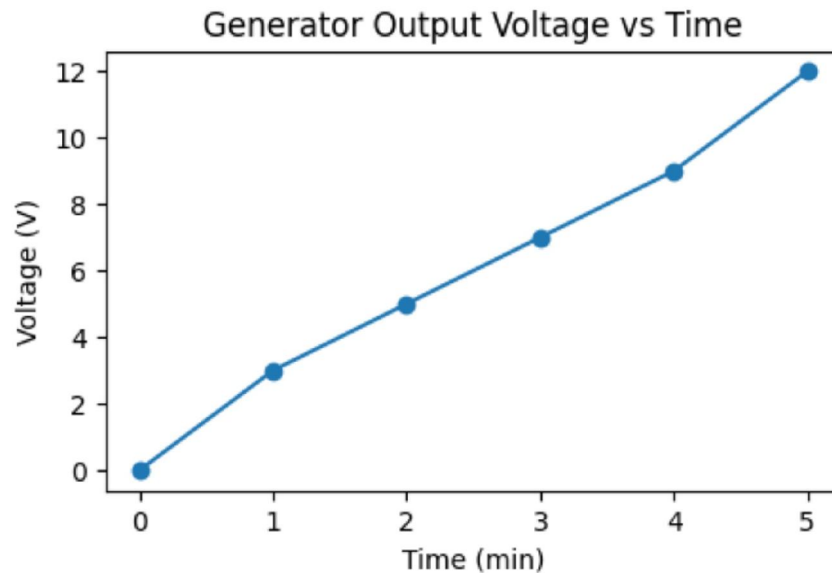


Figure 3: Generator Output Voltage vs Time

### XIV. ADVANTAGES

- Environment friendly and pollution free
- No chemical degradation or toxic waste



- Long operational life
- Low maintenance requirements

#### XV. LIMITATIONS

- Requires large vertical space
- Mechanical friction reduces efficiency

#### XVI. APPLICATIONS

- Renewable energy storage systems
- Rural electrification and microgrids
- Emergency backup power
- Educational demonstrations

#### XVII. CONCLUSION

The project successfully designed and implemented a solar-powered gravity battery prototype for energy storage applications.

#### XVII. FUTURE SCOPE

- Increase height and counterweight mass
- Use IoT-based automation and sensors
- Improve efficiency using advanced gear systems

Detailed Bill of Materials

Sr. No.	Component	Quantity	Cost (₹)
1	Solar Panel	1	1500
2	DC Motor	1	800
3	Electric Dynamo	1	600
4	Pulley Wheel	1	300
5	Rope / Cable	1	200
6	Counterweight Material	1	500
7	Steel Frame Material	1	2000
8	Electrical Wires	As Required	200
9	Switches	2	100
10	Nuts, Bolts & Bearings	-	550
	<b>Total Cost</b>		<b>6750</b>

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