DESIGN AND CONSTRUCTION OF A PEDAL POWERED ELECTRICITY GENERATOR

A thesis
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Submitted to the
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In partial fulfilment of the requirement for the award of the degree
of
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APPROVAL

This is to certify that the project on **" Pedal Powered Electricity Generator Project"** By Md. Omar Ali ID: ME2102024099, Md Tariqul Islam ID: ME2102024362, Md. Roknuzzaman ID: ME2102024041, Imran Hossain ID: ME2102024011 and Lingkon ID: ME2102024018 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 2020 and has been approved as to its style and contents.

…….
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DECLERATION

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. Mahfujul Islam, Lecturer & Asst. Course Coordinator, 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.

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ABSTRACT

In the face of growing energy demands and environmental concerns, sustainable and renewable energy solutions have become a priority. The Pedal Powered Electricity Generator is an innovative project that harnesses human mechanical energy to produce electricity. By integrating a simple pedal-driven mechanism with an electrical generator, this system transforms kinetic energy from pedaling into usable electrical energy.

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Chapter 1

Introduction

1.1 General

As the world moves toward sustainable energy solutions, pedal-powered electricity generators present an innovative and eco-friendly way to produce energy. This project explores the concept of harnessing human kinetic energy through pedaling to generate electricity, providing a renewable and cost-effective energy source.[1]

The pedal-powered electricity generator is based on a simple mechanism: the conversion of mechanical energy produced by pedaling into electrical energy using a dynamo or alternator. This generated electricity can be stored in batteries or directly used to power devices. Such systems are particularly beneficial in areas with limited or no access to conventional power sources.

The primary objectives of this project include:

Demonstrating the practicality of converting human effort into usable electrical energy.

Promoting awareness of renewable energy solutions and their importance in reducing carbon footprints.

Creating a cost-effective and portable power generation system suitable for remote locations, emergency use, or recreational activities.

This project has applications in various fields, such as powering small electronics, educational tools for teaching energy concepts, and offering fitness enthusiasts a way to channel their efforts into generating clean energy. With its simplicity and scalability, the pedal-powered electricity generator can contribute to global efforts in sustainable energy development.[3]

1.2 Objective of the Project

The primary objective of the Pedal Powered Electricity Generator Project is to design and develop a sustainable energy system that converts human kinetic energy into electrical energy. This project aims to:

- To utilize the mechanical energy for generating Electricity
- To provide a reliable power generating machine
- To develop cost effective method

1.3 Background of the Project

The growing need for sustainable and renewable energy sources has spurred innovative approaches to energy generation. Among these, the pedal-powered electricity generator offers a practical and eco-friendly solution by harnessing human kinetic energy to produce electricity. The concept is grounded in the fundamental principles of energy conversion, where mechanical energy from pedaling is transformed into electrical energy using a generator or dynamo.

Historically, pedal-powered systems have been used in various applications, such as powering sewing machines, agricultural equipment, and even early communication devices like telegraphs. Over time, technological advancements have made it possible to adapt this mechanism for electricity generation, addressing modern energy demands.

This project is particularly relevant in today's context for several reasons:

- Energy Crisis: With the depletion of fossil fuels and rising energy costs, alternative energy solutions like pedal power can provide a reliable and sustainable option.
- Rural and Remote Applications: Many areas still lack access to grid electricity. Pedal-powered generators offer an accessible and portable energy source for such locations.
- Environmental Concerns: As carbon emissions and environmental degradation become pressing issues, renewable energy sources like pedal power play a crucial role in reducing the carbon footprint.
- Health and Productivity: Pedal-powered systems combine physical exercise with energy production, promoting a healthy lifestyle while addressing energy needs.
- This project builds on the idea of empowering individuals to generate electricity through their physical effort. It emphasizes affordability, portability, and sustainability, making it suitable for various applications, including educational tools, emergency backup systems, and small-scale renewable energy solutions.

1.4 Earlier Research

Pedal-powered electricity generation is not a new concept; it has been studied and developed in various forms over the years. Earlier research in this field has explored the feasibility, efficiency, and applications of converting human kinetic energy into electrical power. These studies provide valuable insights into the potential and limitations of such systems.

- Initial Applications: The use of human-powered mechanisms dates back to the early 20th century, with applications in mechanical devices like pedal-powered sewing machines and water pumps. Research in the mid-20th century expanded this concept to electricity generation, focusing on dynamo systems that convert rotational energy into electrical energy.
- Educational and Demonstration Tools: Pedal-powered generators have been used as educational tools to teach the principles of energy conversion and efficiency. Research highlighted their effectiveness in demonstrating how physical effort translates to electrical output, providing a hands-on learning experience for students.
- Technological Advancements: Studies in the late 20th century introduced improved dynamo and alternator designs to enhance the efficiency of energy conversion.
- Research also focused on integrating rechargeable batteries to store energy, making the systems more practical for continuous or intermittent use.
- Health and Fitness Integration: Researchers have explored the integration of pedal-powered generators in fitness equipment, such as exercise bikes. These systems allow users to generate electricity while working out, promoting both health and sustainability.
- Sustainability and Environmental Impact: Studies have evaluated the environmental benefits of pedal-powered generators compared to fossil fuel-based energy sources. Findings consistently highlight their potential to reduce carbon emissions and encourage renewable energy practices.

1.5 Brief Overview of the Project

The Pedal Powered Electricity Generator Project is a renewable energy initiative that converts human kinetic energy into electrical energy through pedaling. This system utilizes a simple mechanism: a pedal-driven chain or belt rotates a dynamo or alternator, which generates electricity. The produced energy can be used directly to power devices or stored in batteries for later use.

This project has several key applications and benefits:

- Energy Generation: Provides a clean, renewable energy source for powering small devices such as lights, fans, and mobile chargers.
- Sustainability: Offers an eco-friendly alternative to fossil fuels, reducing carbon emissions and environmental impact.

- Accessibility: Acts as a reliable power source in areas without grid electricity, such as remote villages, disaster-affected regions, and off-grid locations.
- Educational Tool: Demonstrates energy principles and renewable energy concepts in an interactive and engaging manner.
- Health and Fitness: Combines physical activity with energy production, promoting a healthy lifestyle while generating electricity.
- This cost-effective, portable, and sustainable solution has potential applications in rural development, emergency scenarios, and even urban environments. It represents a practical step toward a greener and more energy-efficient future.

1.6 Motivation for Project

The motivation for developing a pedal-powered electricity generator stems from several social, environmental, and technological factors:

- Energy Crisis: The increasing global demand for electricity, coupled with the depletion of fossil fuels, highlights the need for sustainable and renewable energy sources. A pedal-powered generator offers an alternative, empowering individuals to produce their own energy.
- Environmental Concerns: Traditional energy generation methods contribute significantly to carbon emissions and environmental degradation. This project promotes a clean energy solution that aligns with global efforts to combat climate change and reduce dependence on non-renewable energy.
- Energy Accessibility: In many remote and underdeveloped areas, access to grid electricity is limited or nonexistent. A pedal-powered generator can provide a portable and reliable source of energy for basic needs such as lighting, communication, and charging devices.
- Educational Value: The project serves as an engaging way to teach the principles of energy conservation, renewable energy, and mechanical-to-electrical energy conversion. It fosters awareness about sustainable practices among students and the community.
- Emergency Preparedness: In emergency situations where conventional power sources are unavailable, such as natural disasters, a pedal-powered generator can provide an immediate and dependable backup energy solution.
- Health and Fitness Benefits: This project combines physical exercise with productive energy generation, encouraging a healthy lifestyle while contributing to energy needs.

It is especially appealing for fitness enthusiasts and gyms that seek to integrate sustainability into their activities.

- Affordability and Simplicity: The pedal-powered generator is a cost-effective and easy-to-implement solution, making it accessible to individuals and communities with limited financial resources or technical expertise.

1.7 Project Management

Effective project management is essential to successfully design, develop, and implement a pedal-powered electricity generator. Below is an outline of the key phases and activities involved in managing this project:

1. Project Initiation

Define Objectives: Establish the primary goals, such as generating sustainable energy, educating users, or providing a backup power solution.

Feasibility Study: Assess the technical, financial, and environmental viability of the project.

Stakeholder Identification: Identify key stakeholders, such as project sponsors, team members, and end users.

2. Planning Phase

Scope Definition: Clearly outline the scope of the project, including deliverables (e.g., a working prototype and documentation). Work Breakdown Structure (WBS): Divide the project into smaller tasks: Research and design.

Procurement of materials and components.

System assembly and testing.

Documentation and user training.

Resource Allocation:

Human resources: Assign roles (e.g., project manager, engineer, technician).

Material resources: Identify and procure components like a dynamo, pedals, alternator, battery, and wiring.

Timeline and Milestones: Develop a Gantt chart or project schedule with key milestones:

Budget Planning: Estimate costs for materials, labor, testing, and contingencies.

3. Execution Phase

Design and Development:

Create schematics and blueprints for the generator.

Assemble the system components, including the pedal mechanism, generator, and electrical circuits.

4. Monitoring and Control Phase

Progress Tracking:

Regularly review progress against the project plan and timeline.

Use tools like progress reports and meetings to ensure alignment.

Risk Management: Identify and mitigate risks, such as delays in material delivery or system failures during testing.

Quality Assurance:

Conduct quality checks to ensure the system meets design specifications.

Test for consistent performance under varying loads.

5. Project Closure

Final Testing and Handover: Ensure the system functions as intended and meets project objectives. Handover the generator to stakeholders or target users.

Project Review: Evaluate the success of the project against initial goals. Document lessons learned for future improvements.

Dissemination:

Present findings and outcomes through presentations, reports, or demonstrations.

Explore opportunities for scaling up or commercializing the system.

Tools and Techniques

Project Management Software: Tools like MS Project, Trello, or Asana to plan and track progress.

Risk Assessment Matrix: To identify and prioritize potential project risks.

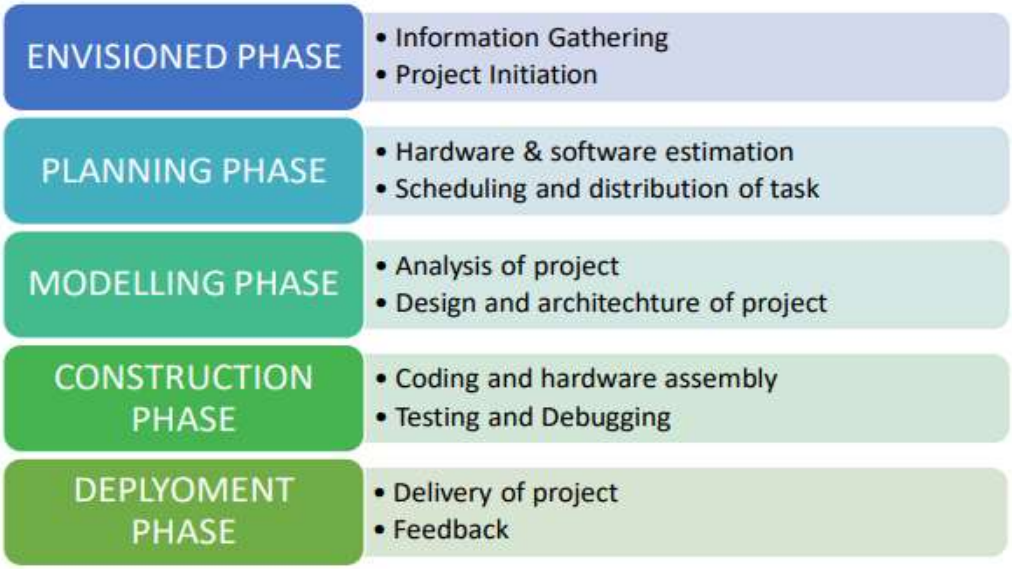


Fig-1.1: Project Management

Chapter 2

Theoretical Review

2.1 Introduction

The use of fossil fuels and other non-reusable sources of energy must be reduced in order to keep emissions low and alleviate the use of diminishing resources. The idea of human powered generation has been implemented in many different situations. Some examples include hand-crank radios, shaking flashlights, and receiving power from gym equipment (William and Jeffrey, 2012). The use of exercise equipment for a clean source of energy would turn out to be an even more fun experience for participants; it would provide them a means to exercise while indirectly generating power. The pedal operated power generator utilizes human energy to produce electricity quickly and efficiently. The goal is to provide technological solution to problem in the rural world by using detailed opportunity recognition, evaluation, and development of prototype. The prototypes are then turned over to the developing world for manufacturing, distribution and use. Less commonly, pedal power is used to power agricultural and hand tools and even to generate electricity. Some applications include pedal powered laptops, pedal powered grinders and pedal powered water wells. Some third world development projects currently transform used bicycles into pedal powered tools for sustainable development. Using human powered generation gives a power source that is not directly derived from natural sources. An example is that a human powered generator can be operated if there is no sun for solar generation, no wind for wind generation, and no water for hydro generation. The power generated from pedal is perfect for remote areas, hilly regions, strategic location, Islands etc., where electricity generation is scanty if not nil. In these situations, a small portable power generating unit would be of great help to provide power supply to charge battery-operated gadgets like mobile phones, lamps, radio, communication devices, etc. It is important to visualize new ways to bring power to the people as population continues to grow and power shortages continue to occur. Much of the power that is provided to people today is done in very un-sustainable ways; new ideas are needed to transit into a post cheap-petroleum era. This design relates to very compact and easily portable power-generating unit, which besides being used as a power generator can also be used as cycle exerciser. It serves dual purpose of power generation and helping the person to maintain physical fitness through exercise of muscles of legs. It can be pedaled or cranked by hand/foot to charge 12-volt batteries and run small appliances.

2.2 System Design

Below is a detailed framework for designing a Pedal-Powered Electricity Generator Project. This document outlines the key steps, components, and considerations necessary for creating a functional and efficient generator system.

- To design and develop a system that converts human mechanical energy into electrical energy.
- To ensure the system is cost-effective, efficient, and ergonomically designed.

- To explore practical applications such as powering small devices, lighting, or charging batteries.
- Components: Bicycle pedals, crankshaft, and chain drive.
- Function: Converts human effort into rotational mechanical energy.
- Design Considerations: Comfortable seating, adjustable pedal resistance, and an optimal pedaling rate (60-90 RPM for efficiency).
- Mechanical-to-Electrical Conversion:
- Options: DC generator, alternator, or permanent magnet generator.
- Selection Criteria: High efficiency, low starting torque, and compatibility with the pedaling speed.
- Purpose: Smoothens the rotational motion and maintains consistent generator speed.
- Design: Made of a high-density material for stability.
- Voltage Regulation: Ensures consistent voltage output despite varying pedaling speeds.
- Rectifier: Converts AC from the alternator to DC for storage and use.
- Charge Controller: Protects the battery from overcharging or discharging.
- Battery: Stores electrical energy for later use.
- Specifications: Lead-acid or lithium-ion battery based on application requirements.
- Applications: Charging mobile devices, powering lights, or small appliances.
- Inverter: Converts DC power to AC if required for the output devices.
- Energy Meter: Displays power generated (in watts) and energy stored.
- Indicators: Provides feedback on battery charge level and generator status.
- Assemble the pedal mechanism, crankshaft, and chain drive system.
- Attach the flywheel and connect it to the generator.
- Electrical System:
- Connect the generator output to the rectifier and charge controller.
- Integrate the battery and connect output devices.
- Measure power output at different pedaling speeds.
- Optimize gear ratios and generator placement for maximum efficiency.
- Test voltage regulation and battery charging under varying loads.
- Ensuring consistent power output despite varying pedaling speeds.
- Reducing energy losses in the mechanical and electrical components.
- Balancing ergonomic design with system efficiency.

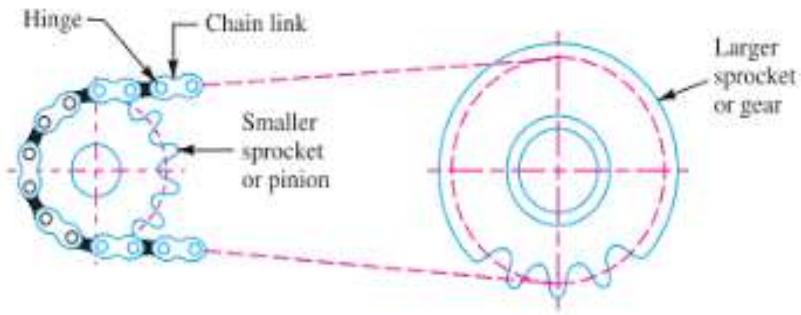


Fig-2.1: Design of Pedal

2.3 Literature Survey

1. Introduction

Pedal-powered electricity generators convert human mechanical energy into electrical energy through the use of a pedal mechanism. These systems are particularly relevant in off-grid or low-resource settings, promoting renewable energy, sustainability, and human health through physical activity.

2. Key Components of Pedal-Powered Generators

Human-Powered Mechanisms: Research highlights ergonomic designs for optimizing power output, such as comfortable seating and efficient pedalling systems. Studies indicate an average human can produce 50–150 watts of continuous power for short durations.

Mechanical-to-Electrical Conversion: Use of alternators, DC generators, or permanent magnet generators is common. Researchers have focused on efficiency, weight, and cost as critical factors.

Energy Storage: Battery systems are often integrated to store electricity, ensuring stable power output and usage flexibility.

3. Applications and Case Studies

Off-Grid Electricity Solutions: Projects in rural areas utilize pedal power for lighting, charging devices, and small appliances. For example, initiatives in India and Africa provide sustainable energy solutions for communities without electricity.

Fitness Equipment Integration: Pedal generators are combined with exercise equipment in gyms to harness energy from workouts. Studies report the feasibility of powering gym lighting and fans.

Emergency Preparedness: Compact pedal generators are designed for disaster scenarios to provide emergency power for communication devices and medical equipment.

4. Benefits

Sustainability: Pedal generators produce clean, renewable energy without reliance on fossil fuels.

Accessibility: Low-cost systems make energy accessible to underprivileged communities.

Health Benefits: Encourages physical activity, promoting health and wellness while generating power.

5. Challenges and Limitations

Low Energy Output: Studies indicate that the energy generated is limited, making it suitable only for low-power applications.

Ergonomics: Long-term use can lead to fatigue; research continues into improving comfort and usability.

System Efficiency: Conversion losses in mechanical and electrical systems are areas of ongoing improvement.

6. Related Research

Energy Conversion Efficiency: Comparative studies of different generator types highlight the efficiency trade-offs between alternators, DC motors, and stepper motors.

Hybrid Systems: Integration with solar or wind energy to create hybrid systems for higher reliability and output.

Educational Tools: Pedal-powered generators are used in schools to teach renewable energy principles.

7. Future Prospects

Integration with smart systems and IoT for real-time energy monitoring and management.

Advanced materials for lightweight and durable designs.

Increased focus on multi-user systems to enhance energy output.

8. Conclusion

Pedal-powered electricity generators are a viable and sustainable solution for low-energy needs in various applications. Continued research into efficiency, ergonomics, and system integration is crucial to improving performance and expanding usage.

2.4 Time Plan

The following tables define the main tasks in the project introduction and project itself.

T1	Project Definition	1 Week
T2	Collecting data	11 Weeks
T3	Analysis	7 Weeks
T4	Theoretical calculation	4 Weeks
T5	Documentation	10 Weeks
T6	Prepare for presentation	2 Weeks

Table- 01: Time Scheduled Table for Project Introduction

The time of the project introduction is scheduled over 16 weeks, table 2 shows how the work was scheduled over this time:

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T1	■															
T2		■	■	■	■	■	■	■	■	■	■	■				
T3				■	■	■	■	■	■	■						
T4						■	■	■	■							
T5					■	■	■	■	■	■	■	■	■	■		
T6															■	■

Table-02: Time Plan Table for Project Introduction

The following table defines the main tasks in the project:

T1	Collecting data	3 Week
T2	Implementation	10 Weeks
T3	Analysis	5 Weeks
T4	Building and testing the system	8 Weeks
T5	Documentation	10 Weeks
T6	Prepare for presentation	2 Weeks

Table-03: Time Scheduled Table for Project

The time of the project is scheduled over 16 weeks, table 4 shows how the work was scheduled over this time:

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T1	■	■	■													
T2			■	■	■	■	■	■	■	■	■	■				
T3				■	■	■	■	■								
T4							■	■	■	■	■	■	■	■		
T5					■	■	■	■	■	■	■	■	■	■		
T6															■	■

Table-04: Time Plan Table for Project

Chapter 3

Methodology

3.1 Process of Project

1. Problem Identification and Objectives: Define the Purpose: Identify the need or problem the generator will address, such as providing off-grid electricity or serving as an educational tool. Set Goals: Specify objectives, such as power output capacity (e.g., charging devices, running lights), cost constraints, and target users.
2. Research and Literature Review: Study existing pedal-powered systems to understand their design, efficiency, and challenges. Analyze technical papers, case studies, and market products to identify design improvements. Explore energy conversion principles, human power output capabilities, and ergonomics.
3. System Design
Mechanical Design: Design the pedal mechanism, crankshaft, and drive system. Incorporate a flywheel for smoother motion. Optimize ergonomic features such as seating and pedal positioning.
Electrical Design: Select a generator or alternator based on desired power output and efficiency. Design the power electronics, including rectifiers, charge controllers, and voltage regulators. Choose an appropriate battery type and capacity for energy storage.
Load Design: Determine the types of devices the generator will power (e.g., lights, USB chargers, fans). Include provisions for connecting multiple devices if required. System Integration: Define how the mechanical and electrical components will work together. Plan for modularity to allow easy upgrades or maintenance.
4. Materials and Component Procurement
Mechanical Components: Pedals, chains, sprockets, flywheel, and support frame. Electrical Components: Generator, rectifier, battery, charge controller, wiring, and output ports. Monitoring Equipment: Energy meters, multimeters, and indicators.
5. Construction and Assembly
Fabrication of the Mechanical System: Assemble the pedal mechanism and drive train.
Attach the flywheel and connect it to the generator using belts or chains.
Electrical Integration: Connect the generator output to the rectifier and voltage regulator.
Wire the charge controller to the battery and output devices. Mounting and Frame Assembly: Build a sturdy frame to hold all components in place. Ensure the frame supports user weight and allows for easy pedaling.
6. Testing and Calibration
Mechanical Testing: Test the smoothness of the pedaling motion and the effectiveness of the flywheel. Check for any mechanical issues, such as misalignment or excessive friction.
Electrical Testing: Measure the generator's output voltage and current at different pedaling speeds. Test the efficiency of the rectifier, charge controller, and voltage regulator.
System Testing: Connect output devices and measure power generation under load.
Test battery charging and discharging cycles. Calibrate the energy monitoring system.
7. Optimization

Improve mechanical efficiency by adjusting the gear ratio or flywheel mass. Optimize electrical efficiency by minimizing losses in the rectifier and wiring. Make ergonomic adjustments to enhance user comfort and sustainability.

8. Documentation and Presentation

Prepare detailed documentation, including: Design schematics and diagrams.

Performance data and test results. User manual and maintenance guide. Create a presentation or report to showcase the project to stakeholders or for educational purposes.

9. Deployment and Use

Install the system in the intended location (e.g., rural areas, gyms, schools). Train users on how to operate and maintain the system. Collect feedback for further improvements.

10. Future Scope and Improvements

Integrate sensors for real-time performance monitoring and data logging. Explore hybrid systems combining pedal power with solar or wind energy. Use advanced materials for a lighter and more portable design.

3.2 Block Diagram of This Project

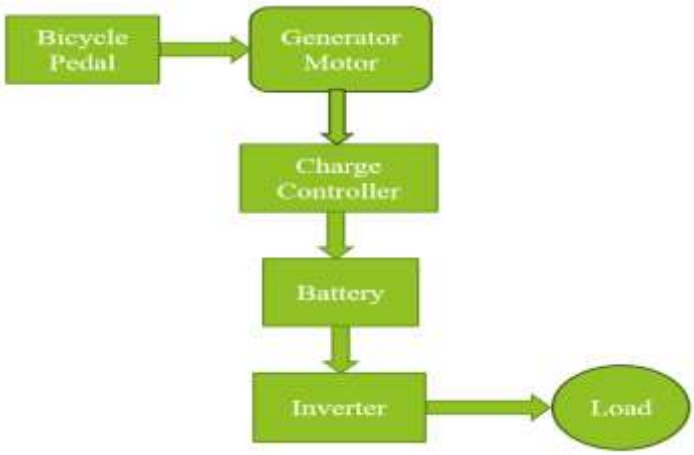


Fig-3.1: Block Diagram

3.3 Circuit Diagram of This Project

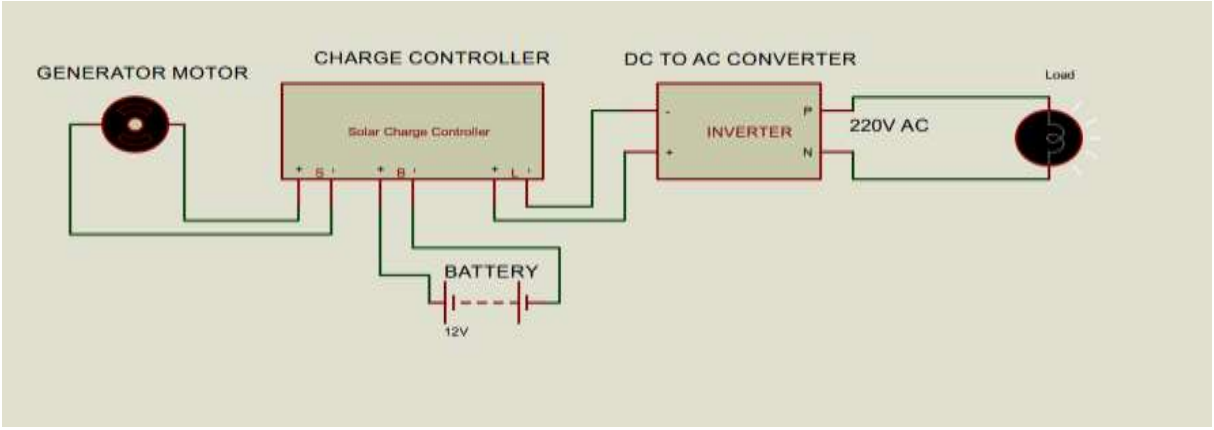


Fig-3.2: Circuit Diagram

3.4 Working Principal

The working principle of a pedal-powered electricity generator is based on converting mechanical energy, generated by human effort through pedaling, into electrical energy. This process involves several stages, including mechanical energy generation, conversion into electrical energy, storage, and utilization. Here's a detailed breakdown of the working principle:

Working Principle of Pedal Powered Electricity Generator

1. Mechanical Energy Generation (Pedaling)

Human Effort: The user begins pedaling on a bicycle or similar mechanism, using their leg muscles to turn the pedals.

Crankshaft and Chain Drive: As the pedals turn, the force is transmitted to a crankshaft. The crankshaft then drives a chain or belt that rotates the flywheel and the attached generator.

Flywheel: The flywheel helps to smooth out the pedaling motion, storing some of the energy and providing a consistent rotational speed to the generator.

2. Mechanical to Electrical Energy Conversion

Generator/Alternator: The rotating motion of the flywheel is transferred to a generator or alternator.

Alternator (or Generator): Inside the generator, mechanical energy is converted into electrical energy. In most systems, the alternator uses a magnet and copper coil setup (or permanent magnets) to generate an alternating current (AC) or direct current (DC) depending on the type of generator used.

AC to DC Conversion: If the generator produces AC, it is often converted to DC using a rectifier, which is important for battery charging or other DC-based loads.

The electromagnetic induction principle is at work here. When a magnet (or rotor) moves through the stationary copper windings (or stator), it induces a flow of electric current in the coils.

3. Voltage Regulation

Voltage Regulation Circuit: Pedal power is not constant; as the user pedals harder, the generator output increases. Therefore, a voltage regulator is used to stabilize the voltage output to ensure that the electrical system (battery or connected devices) receives a steady voltage regardless of varying pedaling speeds.

If the system is built with a DC generator, this is a straightforward process; if using an AC generator, the AC is rectified first before regulation.

4. Energy Storage (Battery Charging)

Battery: The electricity generated is directed to a battery for storage. Depending on the system’s configuration, batteries can be lead-acid, lithium-ion, or any other type suitable for the intended application.

The charge controller manages the charging process, preventing overcharging or discharging of the battery and ensuring the battery is charged at the right voltage.

5. Power Utilization

Powering Devices: Once the battery is charged, the electrical energy can be used to power various devices, such as lights, fans, mobile phones, or small appliances.

If the system is designed for AC devices, an inverter will be used to convert the DC power from the battery to AC for powering devices like lamps or household electronics.

6. Monitoring and Feedback

Energy Meter/Display: The system can include an energy meter that displays the amount of energy generated and the battery charge level. This allows users to monitor their efforts and how much power they are producing.

Feedback Mechanism: Some systems may provide feedback through indicators or a display, showing the battery’s charge level or whether the system is functioning optimally.

Summary of the Process:
Pedaling Motion → User pedals, creating rotational mechanical energy.
Mechanical Energy Transfer → Pedal movement drives a crankshaft, which rotates the flywheel.
Energy Conversion → Flywheel motion drives the generator, converting mechanical energy into electrical energy.
Voltage Regulation → Voltage stabilizers ensure constant power output for the battery or load.
Energy Storage → Electricity is stored in a battery for later use.
Power Supply → Stored energy is used to power various devices or appliances.
Important Considerations:
Human Power Output: The average person generates about 50–150 watts of continuous power during moderate pedaling, which is sufficient for small applications like lighting and charging small devices.
Efficiency Losses: Mechanical and electrical losses (in the generator, wiring, and other components) mean the output will be less than the input power.
System Scaling: The system can be scaled by adding more generators or integrating with renewable energy sources like solar to provide additional power.
This system works efficiently in environments where power generation needs are low, and human effort can be consistently applied. Would you like additional details or a more specific explanation on any part of the process?

3.5 The list of Devices used in the Project is Given Below

- Bicycle Gear.
- Generator Motor.
- Charge Controller.
- Battery.
- Inverter.

3.6 Bicycle Gear

A bicycle gear is an essential component of a bicycle's drivetrain that helps adjust the pedaling difficulty and speed by changing the mechanical advantage between the pedals and the wheels. Gears are particularly important in pedal-powered electricity generators because they enable the adjustment of pedaling speed and torque to optimize the power generation for different applications.
Bicycle Gear: Function and Working
1. Purpose of Bicycle Gears
Control Pedaling Resistance: Bicycle gears allow the rider to change the resistance felt while pedaling, making it easier to pedal uphill or harder to generate more speed on flat ground.
Adjust Speed and Torque: By changing gears, the rider can adjust the balance between speed (higher cadence) and torque (force applied to the pedals). This helps maintain an efficient pedaling rate and optimizes power output in various conditions.
2. Components of a Bicycle Gear System

Chainring(s): The chainring is the large toothed wheel at the front of the bike connected to the pedals. The number of teeth on the chainring determines how much the pedals must rotate to move the bike forward. Larger Chainrings make pedaling harder but allow higher speeds.
Smaller Chainrings make pedaling easier but result in lower speeds.
Cogs (Rear Sprockets): These are the multiple gears located on the rear wheel hub. A cassette or freewheel is made up of several cogs of varying sizes. Shifting between these cogs changes the gear ratio. Larger Cogs provide higher torque but lower speed (ideal for climbing). Smaller Cogs provide lower torque but higher speed (ideal for flat terrain).
Derailleur: The derailleur is the mechanism responsible for shifting the chain from one cog or chainring to another. It uses a jockey wheel and a spring to move the chain across the gears when the rider operates the shifter.
Shifters: Shifters are levers on the handlebars that control the derailleur. When a rider shifts gears, the shifter adjusts the position of the derailleur, moving the chain to a different cog or chainring.
Chain: The chain connects the chainring to the cogs and transmits power from the pedals to the rear wheel. The length and tension of the chain are critical for smooth gear transitions and efficient power transfer.
3. Gear Ratios
Gear Ratio is a mathematical relationship between the number of teeth on the front chainring and the number of teeth on the rear cog. The gear ratio determines how many times the wheel turns for each full pedal stroke.
Low Gear (Easy Pedaling): A smaller front chainring combined with a larger rear cog results in a low gear, where the rider pedals faster but with less force.
High Gear (Harder Pedaling): A larger front chainring with a smaller rear cog results in a high gear, where the rider applies more force per pedal stroke but moves faster. For example, if a chainring has 48 teeth and a rear cog has 16 teeth, the gear ratio is 3:1. This means the rear wheel turns three times for every full rotation of the pedals.
4. Gears in a Pedal-Powered Generator System
In a pedal-powered electricity generator system, gearing plays a vital role in ensuring optimal performance. Here’s how bicycle gears can enhance the power generation process:
Speed Control: Gears allow the rider to maintain an optimal pedaling speed (typically around 60-90 RPM) that matches the generator's operating speed. For example, in a high gear, a rider may have to pedal harder (more torque), which could be useful for turning a generator faster.
Torque Adjustment: The gear system helps adjust the torque needed to generate electricity. If more torque is needed to turn the generator under a load, a lower gear (larger rear cog or smaller front chainring) can be engaged, making it easier to generate power at slower pedaling speeds.
Efficiency and Optimization: A well-selected gear ratio helps the rider maintain a consistent, sustainable effort, preventing fatigue while maximizing the energy output. Using lower gears may allow a more sustainable pedal speed, preventing excessive strain while providing consistent power.
5. Types of Bicycle Gears

Single-Speed Gear: A simple gear setup with one gear ratio. This system is most common on fixed-gear or minimalist bicycles. It’s efficient but lacks the versatility of multi-speed systems.
Derailleur Gears (Multi-Gear): A system that allows the rider to shift between multiple gears, typically consisting of several cogs at the rear wheel and a chainring at the front. This is ideal for varying terrain and pedal power optimization.
Internal Hub Gears: Gears are housed inside the rear wheel hub and offer a more compact and low-maintenance system. Although more durable, they are typically heavier and less efficient than derailleur systems for high-power applications like generating electricity.

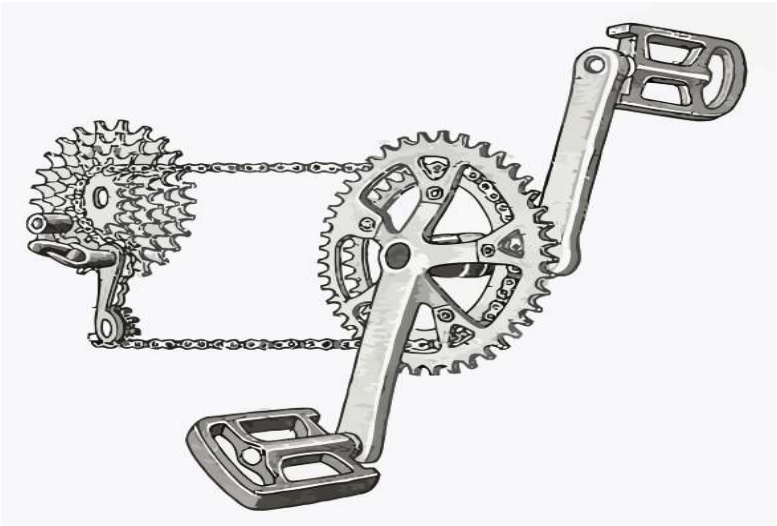


Fig-3.3: Bicycle Gear

3.7 Generator Motor

A dynamo motor (often simply referred to as a dynamo) is a type of electrical generator that converts mechanical energy into electrical energy using electromagnetic induction. The term "dynamo" was originally used to describe a type of machine that generated direct current (DC) electricity, but the principle applies to many different forms of mechanical to electrical energy conversion, including in pedal-powered systems.
In the context of a pedal-powered electricity generator, the dynamo motor plays the crucial role of converting the rotational mechanical energy produced by pedaling into electrical energy, which can then be stored or used to power devices.

3.7.1 Specifications

- Motor Name: Power Generator Motor
- Model: DN-8112
- Voltage: DC220v-240V
- Quality: Class 180
- Power: 800w
- Motor diameter: 42MM
- Motor length: 81.3MM

- Output shaft: 5.1MM (it is the flower shaft)
- Outlet length: 16.5MM. (From the panel)
- Screw hole: M 3.5
- Screw hole pitch: 29.5MM
- Weight: 450gm



Fig-3.4: Generator Motor

3.8 Charge Controller

A charge controller is an essential component in any energy generation and storage system, including pedal-powered electricity generators. Its primary function is to manage the flow of electricity from the generator (or other power sources) to the battery, ensuring safe and efficient charging. The charge controller prevents overcharging, over-discharging, and damage to the battery, which can significantly extend the lifespan of the energy storage system.

3.8.1 Specifications

- Load Capacity: 100 Watt
- Charging Volt: 12 Volt
- Ampere Rating: 1-10 Amp.
- Self-Consumption: 0.008 Amp. (8mA)
- Indicator by LED Display: Indicating by Six LED’s
- High Voltage Cut: 14.6 Volt ± 0.02 Volt
- Low Voltage Cut: 11.6 Volt ± 0.02 Volt
- Charge Re-connect: 14.0 Volt ± 0.02 Volt
- Load Re-connection from LVD: 12.6 Volt ± 0.02 Volt



Fig-3.5: Charge Controller

3.9 Battery

Battery has a nominal voltage of 12 V. It comes with a capacity of 9Ah for 20HR(10.5V), 8.4Ah for 10HR(10.5V), and 5.8Ah 1HR(9.60V). This Battery is equipped with High-performance plates and electrolytes to give extra power output for a common power backup system. This battery offers Heavy Duty Grid and mechanized assembly. It has a non-spillable construction and can deliver high reliability and stability.

3.9.1 Specifications

- Capacity: 9AH
- Voltage: 12 Volt
- Capacity: 9Ah
- Charging Time: 10 Hours
- Nominal Voltage: 12V



Fig-3.6: Battery

3.10 Inverter

An inverter is a device that converts direct current (DC) electrical energy into alternating current (AC). In the context of a pedal-powered electricity generator, an inverter plays a crucial role if you want to use the generated energy to power AC devices or appliances (such as lights, fans, or household electronics). An inverter is an essential component of a pedal-powered electricity generator system if you need to convert DC power into AC for household appliances or devices. Inverters come in different types, including pure sine wave, modified

sine wave, and square wave, each offering varying levels of efficiency and compatibility with devices. By using an inverter, you can significantly expand the range of devices that can be powered by a pedal-powered generator, making the system more versatile and practical for daily use.

3.10.1 Specifications

- Input voltage: DC12V
- OutputVoltage:AC220V
- Peak-power: 500W
- Continuous output power: 150-300W
- Conversion efficiency: Greater than 90%
- Frequency:50Hz
- Under-voltage shutdown: 10.5VDC
- Low-voltage alarm: 10.5VDC
- Overload-shutdown: Yes
- Short-circuit shutdown: Yes
- Net-weight: 0.60Kg
- Gross-weight: 0.95Kg
- Dimensions:16.3X5.4X5.5CM

Chapter 4

Data and Calculation

4.1 Data Table

S/N	RPM	Time	Generating Source	Voltage	Current
1	300	2 min	DC	3V	0.6A
2	500			5V	0.9A
3	800			6V	1.1A
4	1000			8V	1.5A

4.2 Sample Calculation:

For Sample 1, Voltage V = 3 V

Current I = 0.6 A

We know that,

Power P= VI= 3×0.6 = 1.8 watt

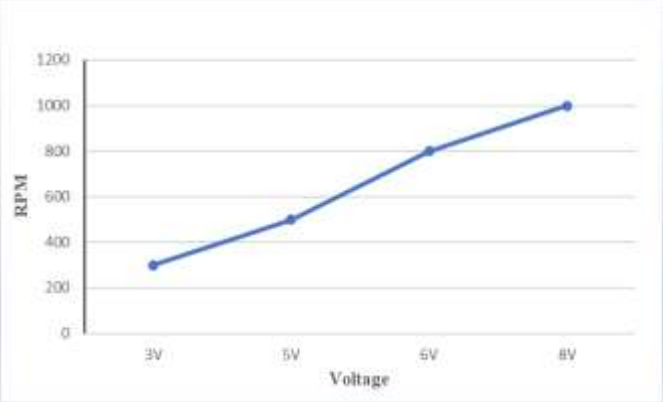
Sample 2, P= VI =5×0.9 = 4.5 watt

Sample 3, P= VI= 6×1.1 = 6.66 watt

Sample 4, P=VI= 8×1.5 = 12 watt

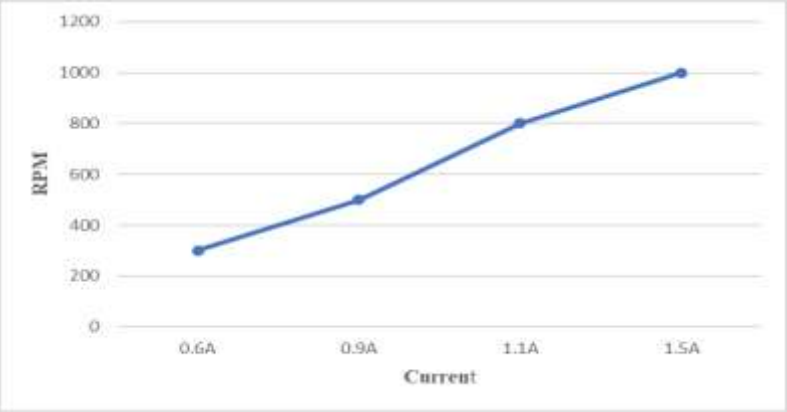
4.3 Graph Line Chart:

RPM and Voltage Graph Line Chart



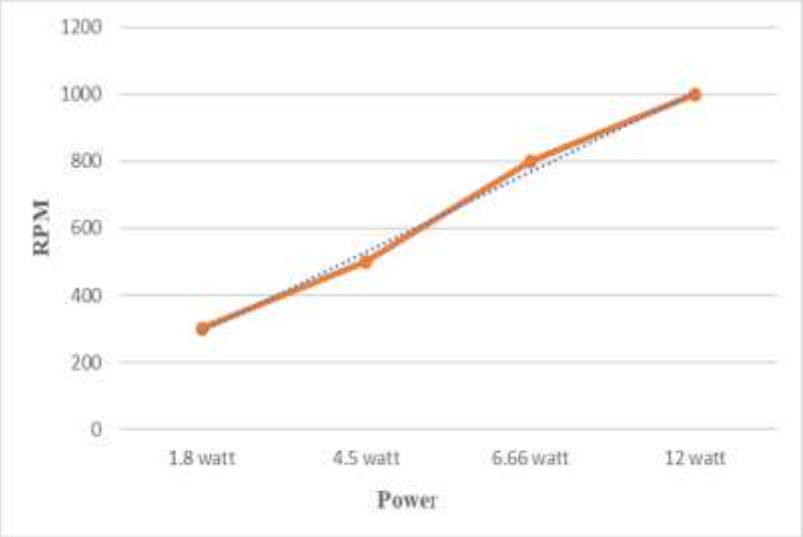
RPM	Voltage
300	3
500	5
800	6
100	8

RPM and Current Graph Line Chart



RPM	Current
300	0.6
500	0.9
800	1.1
1000	1.5

RPM and Power Graph Line Chart



RPM	Power
300	1.8
500	4.5
800	6.66
1000	12

Chapter 5

Result and Discussion

5.1 Result

The result of a Pedal Powered Electricity Generator Project can be evaluated from various aspects such as the efficiency of the energy conversion, the power generated, the sustainability of the system, and its effectiveness in charging devices or running appliances. Below is an outline of possible results that can emerge from this type of project.

1. Power Generation Efficiency

DC Power Output: The amount of power generated by pedaling typically depends on several factors, including the mechanical setup (gear ratio, dynamo efficiency, pedal speed), and the rider's physical effort. A typical pedal-powered generator might produce between 50-100 watts of power under normal conditions. This output can vary based on the generator's design and how hard the rider pedals.

AC Power Output (via Inverter): After converting DC power to AC via an inverter, the usable AC power will typically be less than the initial DC power due to conversion losses. The system might output 20-80 watts of usable AC power depending on the inverter's efficiency and the load on the system.



Fig-4.1: Project Picture

2. Battery Charging Capacity

Battery Charging Efficiency: If the system is designed to charge a battery, the charge controller ensures safe and efficient battery charging. The total amount of power stored in the battery depends on the total energy generated during pedaling and how much power is consumed by the inverter and any other connected devices. A typical system might charge a 12V battery with 100-200 watt-hours (Wh) of energy, enough to power low-energy devices (e.g., LED lights, small fans, or a phone charger) for several hours.

3. System Sustainability

Energy Storage: The ability to store energy in a battery enables the system to be useful even when pedaling is not ongoing. This energy storage makes the system independent of the grid and ensures that power is available when needed.

Renewable and Eco-Friendly: The system harnesses human energy for electricity generation, making it a green energy source. This project reduces reliance on fossil fuels and promotes sustainability.

4. Practical Use and Power Supply

Powering Small Devices: The pedal-powered system can successfully power small, low-wattage devices such as LED lights, small radios, or USB chargers. For example, a 5W LED bulb could run for about 10 hours using 50W of stored energy.

Charging Devices: It can charge smartphones, tablets, or other small electronics, typically using DC power (via a USB charging port) or converting DC to AC to charge devices designed for household power outlets.

5.2 Discussion

The Pedal Powered Electricity Generator Project is a fascinating and educational project that explores the intersection of renewable energy, human-powered energy generation, and sustainable living. It combines principles of mechanical engineering, electrical engineering, and sustainability, and provides an alternative method of power generation using human effort. Below is a detailed discussion of the project, addressing its objectives, challenges, benefits, and potential improvements.

Chapter 6:

Conclusion & Recommendation

6.1 Advantage

The Pedal Powered Electricity Generator project offers numerous advantages, making it an innovative and practical solution for sustainable energy production. Here are the key benefits:

1. Renewable Energy Source
2. Eco-Friendly
3. Cost-Effective
4. Portable and Versatile
5. Health and Fitness Benefits
6. Educational Value
7. Low Maintenance
8. Promotes Energy Awareness

6.2 Application

The Pedal Powered Electricity Generator project has a wide range of applications, demonstrating its versatility and practicality in various contexts. Here are some key areas where it can be used:

- Educational Tool
- Emergency Power Source
- Fitness and Energy Generation
- Lighting Solutions

6.3 Future Scope

The Pedal Powered Electricity Generator project lays the foundation for sustainable energy production using human effort. However, there is significant potential for further development and enhancement to make the system more efficient, versatile, and user-friendly.

6.4 Conclusion

The Pedal Powered Electricity Generator is a versatile and impactful project that bridges the gap between human effort and sustainable energy. It not only provides practical solutions for energy needs but also inspires a mindset of conservation and self-reliance. The project holds great potential for addressing energy challenges in a sustainable, eco-friendly, and health-conscious manner, making it a valuable innovation for individuals and communities alike.

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