

Conversion of Mechanical Energy to Electrical Energy By Using Two-Wheeler Engine Component (GENIE ON WHEELS)

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Abstract- The demand for portable and low-cost electricity generation systems is increasing due to frequent power shortages and the need for emergency power sources. Internal combustion engines used in two-wheelers produce significant mechanical energy during operation, which can be utilized for electricity generation. This project focuses on converting the mechanical energy produced by a two-wheeler engine into electrical energy using a generator or alternator system. In this project, a two-wheeler petrol engine is used as the prime mover to drive a generator through a suitable coupling or belt drive mechanism. The rotational mechanical energy of the engine shaft is transmitted to the generator rotor, which converts it into electrical energy based on the principle of electromagnetic induction. The generated electricity can be used for small electrical loads or for battery charging purposes. The system design includes proper mechanical alignment between the engine and generator, a stable base frame, and electrical components such as voltmeters, ammeters, and voltage regulators to monitor and control the electrical output. The performance of the system is evaluated by conducting tests under different operating conditions and load variations. The results show that a two-wheeler engine can effectively generate electrical energy when properly coupled with a suitable generator. The project demonstrates that existing vehicle components can be reused to develop a low-cost, portable electricity generation system. This concept can be useful in rural areas, workshops, and emergency situations where grid electricity is not available. Overall, the project highlights the practical application of mechanical-to-electrical energy conversion using two-wheeler engine components and provides a simple and economical solution for small-scale power generation.

industrial, and commercial applications. With the increasing demand for electrical power and frequent power shortages in many areas, there is a need for alternative and portable power generation systems. One possible solution is the conversion of mechanical energy into electrical energy using small internal combustion engines.

Two-wheelers such as motorcycles and scooters are widely used vehicles powered by internal combustion engines. These engines produce mechanical energy in the form of rotational motion of the crankshaft during fuel combustion. Normally, this mechanical energy is used only to move the vehicle, while a small portion is used to charge the battery through the alternator. However, the mechanical power generated by the engine can also be utilized for generating electrical energy by connecting the engine to a suitable generator.

The principle of converting mechanical energy into electrical energy is based on electromagnetic induction. When a conductor rotates in a magnetic field, an electromotive force (EMF) is produced, which generates electrical current. In this project, the two-wheeler engine acts as the prime mover that drives a generator through a mechanical coupling or belt drive system. The generator converts the rotational mechanical energy of the engine into electrical energy that can be used for small electrical loads.

I. INTRODUCTION

Energy plays a vital role in the development of modern society. Electricity is one of the most important forms of energy used for domestic,



This project focuses on designing and developing a simple and cost-effective system that uses a two-wheeler engine to produce electricity. The system includes an engine, generator, power transmission mechanism, supporting frame, and measuring instruments such as voltmeter and ammeter to monitor the electrical output.

The main advantage of this system is that it uses easily available components and requires relatively low investment compared to conventional generators. It can be useful in rural areas, workshops, construction sites, and emergency situations where electricity supply is not available or unreliable.

Thus, the project demonstrates the practical application of mechanical-to-electrical energy conversion and highlights the potential use of two-wheeler engine components for small-scale electricity generation.

II. PROBLEM STATEMENT

In many regions, especially rural and semi-urban areas, the supply of electricity is often unreliable due to frequent power cuts, low voltage problems, and limited access to grid power. These issues create difficulties in operating small electrical devices,

workshops, and essential equipment. Portable generators are commonly used as backup power sources, but they are often expensive, require additional fuel consumption, and need regular maintenance. Therefore, there is a need for a simple, economical, and portable method of generating electricity.

Two-wheelers such as motorcycles and scooters are widely available and commonly used for transportation. Their internal combustion engines produce significant mechanical energy during operation. However, most of this mechanical energy is used only for vehicle movement, and only a small portion is used to charge the battery through the alternator. The remaining mechanical energy is not fully utilized for other useful applications.

At the same time, many small electrical loads such as lighting systems, battery chargers, and small appliances require only a limited amount of electrical power. If the mechanical energy produced by a two-wheeler engine can be effectively converted into electrical energy, it could serve as a practical solution for temporary or emergency power generation.

The main problem addressed in this project is how to design and develop a system that can efficiently convert the mechanical energy produced by a two-wheeler engine into usable electrical energy. The system must be economical, easy to assemble, portable, and capable of generating stable electrical output without significantly affecting the performance of the engine.

Thus, the project aims to utilize available two-wheeler engine components as a prime mover for a generator system to produce electrical power for small-scale applications

III. LITERATURE REVIEW

The literature review is an important part of any engineering project because it helps in understanding the previous research and developments related to the topic. Various researchers and engineers have studied the conversion of mechanical energy into electrical energy using internal combustion engines and generator systems. Small petrol engines, such as those used in motorcycles and scooters, are capable

of producing sufficient mechanical power that can be used for electricity generation.

This section reviews earlier studies, books, and technical papers related to engine-driven generators, mechanical power transmission, and electrical energy generation.

1. Studies on Internal Combustion Engines

Internal combustion engines are widely used as prime movers in power generation systems. According to Internal Combustion Engine Fundamentals, the combustion of fuel inside the engine cylinder produces high-pressure gases that push the piston and generate mechanical power. This mechanical energy is transmitted through the crankshaft as rotational motion.

Research shows that a typical petrol engine converts only about 30–35% of fuel energy into useful mechanical energy, while the remaining energy is lost through heat, exhaust gases, and friction. This indicates that improving the utilization of mechanical energy can increase overall system efficiency.

2. Research on Mechanical to Electrical Energy Conversion

The conversion of mechanical energy into electrical energy is based on the principle of electromagnetic induction. When a conductor moves through a magnetic field, an electromotive force (EMF) is generated. This principle is used in generators and alternators.

Electrical engineering studies such as Electrical Machines explain that a generator converts rotational mechanical energy into electrical energy using a rotating magnetic field and conductive coils. When the rotor rotates inside the stator, electrical energy is produced at the output terminals.

This concept is widely used in power plants where turbines rotate generators to produce electricity.

3. Studies on Small Engine Generator Systems

Several research studies have focused on small petrol engines driving generators for portable power

generation. Portable generator sets commonly use small engines ranging from 1 kW to 5 kW capacity.

Research findings show that:

- Direct shaft coupling improves mechanical efficiency.
- Belt drive systems allow flexible speed adjustment.
- Stable engine speed is necessary for constant voltage output.
- Proper alignment of mechanical components reduces vibration and power loss.

These findings are useful for designing small-scale electricity generation systems using two-wheeler engines.

4. Research on Waste Energy Utilization

Many researchers have also investigated the recovery of waste energy from vehicle engines. For example, the research paper Performance Study of Thermo-Electric Generator by Heat Exhaust with Two-Wheel Motorcycle studies electricity generation from motorcycle exhaust heat using thermoelectric modules.

The research demonstrated that exhaust heat can produce electrical energy up to 21.86 V and 0.55 A, which can be used for charging a 12 V battery. Although the output power is relatively small, it proves that motorcycles can serve as alternative energy sources.

5. Importance of Speed Control

Previous studies also emphasize that maintaining constant engine speed is essential for generator operation. Fluctuations in engine speed cause voltage variations in the generator output.

Methods used for speed control include:

- Mechanical governor systems
- Throttle adjustment
- Flywheel energy storage

These mechanisms help maintain stable generator performance.

6. Research Gap

Although many studies have been conducted on generator systems and energy recovery methods, there is limited research specifically focused on converting mechanical energy from two-wheeler engines into electrical energy for small-scale portable power generation. Therefore, this project attempts to design a simple and economical system that utilizes easily available two-wheeler components for electricity generation

IV. MECHANICAL METHODOLOGY

Mechanical methodology refers to the step-by-step mechanical design and implementation process used to convert the mechanical energy produced by a two-wheeler engine into electrical energy. It mainly focuses on the mechanical components such as the engine, coupling system, frame structure, and power transmission mechanism that are required to drive the generator.

The mechanical system ensures that the rotational motion produced by the engine is effectively transmitted to the generator for electricity generation.

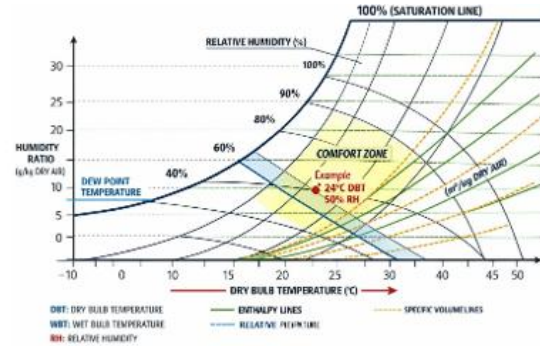
1. Selection of Prime Mover (Engine)

The first step in the mechanical methodology is selecting a suitable two-wheeler engine to act as the prime mover.

Selection criteria include:

- Engine capacity (100–150 cc)
- Good compression condition
- Stable RPM operation
- Adequate torque output

The engine produces rotational mechanical energy through the combustion of petrol inside the cylinder. This energy is transmitted through the crankshaft.



2. Power Transmission Mechanism

The mechanical power generated by the engine must be transmitted to the generator shaft. Two main transmission methods are considered:

I. Direct Coupling

- Engine shaft directly connected to generator shaft
- High efficiency
- Minimal power loss

II. Belt and Pulley System

- Flexible speed adjustment
- Easy installation
- Slight energy loss due to belt friction

For this project, a belt and pulley system or flexible coupling can be used depending on generator speed requirements.

3. Frame and Structural Design

A strong base frame is required to support the engine and generator.

Frame design considerations:

- Material: Mild steel
- Rigid rectangular structure
- Proper mounting holes for engine and generator
- Anti-vibration rubber mounts

The frame provides stability during operation and prevents excessive vibration.

4. Shaft Alignment

Proper shaft alignment between the engine and generator is necessary for smooth operation.

Poor alignment can cause:

- Vibration
- Power loss
- Bearing damage

Alignment is achieved using:

- Adjustable mounting brackets
- Accurate positioning of shafts
- Coupling alignment tools

5. Flywheel Effect

The flywheel attached to the engine crankshaft stores kinetic energy during operation. This stored energy helps maintain uniform rotational speed and reduces speed fluctuations. A stable rotational speed is essential for maintaining constant generator output voltage.

6. Cooling and Ventilation

Since the engine generates heat during operation, proper ventilation must be provided.

Cooling considerations:

- Engine air-cooling fins exposed to air
- Open frame structure
- Adequate spacing between components

Proper cooling ensures safe and efficient operation.

7. Safety Considerations

Mechanical safety measures include:

- Protective guard for rotating parts
- Proper tightening of bolts and fasteners
- Stable mounting of engine and generator
- Safe handling of fuel

These measures help prevent accidents during operation.

8. Mechanical Working Principle

The working process of the mechanical system can be summarized as follows:

Fuel Combustion in Engine

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Piston Movement

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Crankshaft Rotation

↓

Power Transmission (Coupling/Belt)

↓

Generator Shaft Rotation

↓

Electrical Energy Generation

Design of machine: -

The design of the machine focuses on developing a system that converts mechanical energy produced by a two-wheeler engine into electrical energy using a generator. The machine consists of mechanical components such as the engine, generator, transmission mechanism, frame structure, and electrical control system.

The design ensures efficient power transmission, structural stability, and safe operation of the system.

1. Main Components of the Machine

The machine designed for this project includes the following major components:

- i. Two-Wheeler Engine (Prime Mover)
- ii. Generator / Alternator
- iii. Power Transmission System (Belt and Pulley or Coupling)
- iv. Base Frame Structure
- v. Shaft and Bearings
- vi. Electrical Control Panel
- vii. Measuring Instruments (Voltmeter and Ammeter)

These components work together to convert mechanical energy into electrical energy.

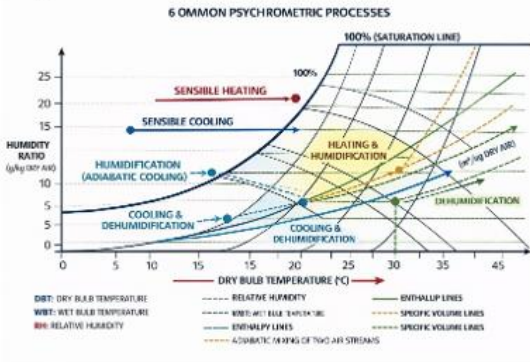
2. Engine Design Consideration

The engine acts as the prime mover of the system.

Design parameters considered:

- Engine capacity: 100–150 cc
- Speed range: 2000–4000 RPM
- Adequate torque output
- Proper cooling system

The engine produces mechanical power through fuel combustion inside the cylinder, which moves the piston and rotates the crankshaft.



3. Generator Design

The generator is used to convert rotational mechanical energy into electrical energy.

Design considerations include:

- Generator rating: 1–2 kW
- Output voltage: 12 V / 24 V / 230 V depending on application
- High efficiency alternator
- Suitable speed requirement

The generator rotor rotates inside a magnetic field, producing electrical energy according to the principle of electromagnetic induction.

4. Power Transmission Design

Mechanical power from the engine must be transferred to the generator.

Two possible designs are used:

A. Direct Coupling

- Engine shaft directly connected to generator shaft
- High efficiency
- No slip loss

B. Belt and Pulley Drive

- Flexible speed adjustment
- Easy installation
- Allows speed ratio changes

Pulley ratio formula:

Where:

$N = \text{Speed (RPM)}$

$D = \text{Pulley diameter}$

5. Frame Design

A rigid base frame is designed to support all components.

Frame specifications:

- Material: Mild Steel Angle
- Strong welded structure
- Proper mounting for engine and generator
- Anti-vibration rubber pads

The frame ensures stability during operation and prevents excessive vibration.

6. Shaft Design

The shaft transmits torque from the engine to the generator.

Design factors:

- Torque transmission capacity
- Torsional strength
- Material: Mild steel

Torque formula:

Where:

$P = \text{Power}$

$N = \text{Speed}$

7. Electrical System Design

Electrical components included in the system:

- Voltage regulator
- Ammeter
- Voltmeter
- Main switch
- Output socket
- Circuit breaker

These components help monitor and control the electrical output of the generator.

8. Safety and Protection

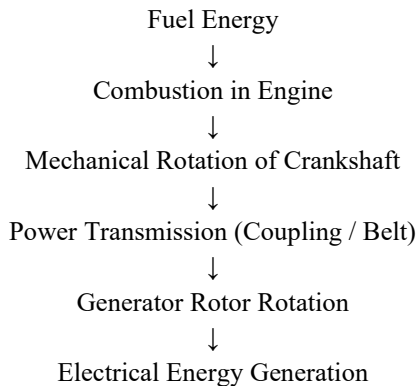
Safety features included in the machine design:

- Proper grounding of electrical system

- Protective guard for rotating parts
- Stable mounting of components
- Adequate ventilation for engine cooling

9. Working Principle of the Machine

The working process of the machine is as follows:



V. CAD

Computer-Aided Design (CAD) is used to create the digital model of the machine before fabrication. CAD helps engineers visualize the structure, dimensions, and arrangement of components in a virtual environment. It also helps in identifying design errors and improving accuracy before manufacturing.

In this project, CAD software is used to design the mechanical structure of the system including the engine mounting frame, generator placement, shaft alignment, and power transmission system.

1. Purpose of Using CAD

The main purposes of using CAD in this project are:

- To create a 3D model of the complete machine
- To ensure proper alignment of engine and generator
- To design a strong and stable base frame
- To visualize component placement before fabrication
- To reduce design errors and improve accuracy

CAD modeling also helps in preparing technical drawings for manufacturing and assembly.

2. CAD Software Used

The following CAD software can be used for designing the system:

- AutoCAD – for 2D engineering drawings
- SolidWorks – for 3D modeling and assembly
- CATIA – for advanced mechanical design
- Fusion 360 – for integrated design and simulation

These tools help in designing the complete system with accurate dimensions and realistic visualization.

3. CAD Model Components

The CAD model of the machine includes the following parts:

- Two-Wheeler Engine Model
- Generator / Alternator Model
- Belt and Pulley or Coupling System
- Base Frame Structure
- Shaft and Bearing Arrangement
- Mounting Brackets
- Electrical Control Panel

Each component is modeled individually and then assembled to form the complete machine design.

4. CAD Design Procedure

The design process using CAD involves the following steps:

- Creating 2D sketches of machine components
- Converting sketches into 3D models
- Designing the base frame structure
- Placing the engine and generator on the frame
- Designing the belt and pulley transmission system
- Performing assembly of all components
- Checking alignment, spacing, and clearances

This process ensures that all components fit properly and function correctly.

5. Advantages of CAD in This Project

Using CAD provides several advantages:

- Accurate machine design
- Better visualization of the system
- Easy modification of design
- Reduced manufacturing errors
- Faster design process

- Improved documentation for fabrication

VI. WORKING

The working of the system explains how mechanical energy produced by a two-wheeler engine is converted into electrical energy using a generator. The system operates based on the principle of energy conversion and electromagnetic induction. The engine acts as the prime mover and provides the mechanical power required to rotate the generator.

1. Basic Working Principle

The system works on the principle that when a conductor rotates inside a magnetic field, an electromotive force (EMF) is generated. This principle is used in generators and alternators to produce electricity.

In this project, the mechanical rotation produced by the engine crankshaft is transmitted to the generator shaft using a coupling or belt drive system. The generator then converts this rotational mechanical energy into electrical energy.

2. Step-by-Step Working Process

The working of the machine can be explained in the following steps:

Step 1: Fuel Combustion in Engine

Petrol fuel is supplied to the engine where it mixes with air and burns inside the combustion chamber. This combustion produces high-pressure gases.

Step 2: Piston Movement

The high-pressure gases push the piston downward inside the cylinder. This movement converts thermal energy into mechanical energy.

Step 3: Crankshaft Rotation

The piston movement is transferred to the crankshaft through the connecting rod. As a result, the crankshaft rotates and produces mechanical rotational motion.

Step 4: Power Transmission

The rotational motion of the crankshaft is transmitted to the generator shaft through a belt and pulley system or direct coupling.

Step 5: Generator Rotation

When the generator shaft rotates, the rotor inside the generator spins within a magnetic field created by the stator.

Step 6: Electricity Generation

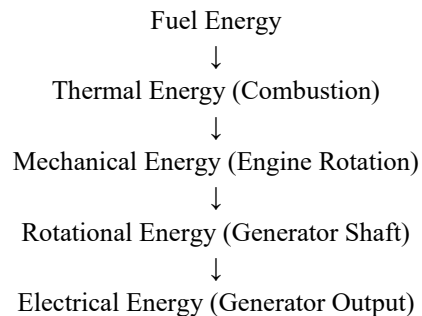
Due to electromagnetic induction, the rotating magnetic field induces an electromotive force (EMF) in the stator windings. This produces electrical current.

Step 7: Electrical Output

The generated electricity flows through the electrical control system, where it is monitored by instruments such as a voltmeter and ammeter. The electricity can then be used to power small electrical devices or charge batteries.

3. Energy Conversion Flow

The energy conversion process in the system can be represented as:



4. Role of Each Component

Engine: Produces mechanical power through combustion.

Transmission System: Transfers rotational motion from engine to generator.

Generator: Converts mechanical energy into electrical energy.

Frame Structure: Provides support and stability for the entire system.

Electrical Control Panel: Monitors voltage, current, and protects the system.

VII. RESULT

The result section presents the performance and output obtained from the developed system. After designing and assembling the machine, several tests were conducted to evaluate its efficiency, stability, and electrical output. The main objective of testing was to verify whether the mechanical energy produced by the two-wheeler engine could be successfully converted into electrical energy.

1. Experimental Observation

During the experiment, the two-wheeler engine was started and operated at different speeds. The engine crankshaft rotation was transmitted to the generator through the belt and pulley system. As the generator rotated, electrical energy was produced and measured using electrical instruments such as a voltmeter and ammeter.

The observations confirmed that the generator successfully produced electrical output when the engine was running at a stable speed.

2. Output Readings

Sample readings obtained during testing are shown below:

Engine Speed (RPM)	Output Voltage (V)	Output Current (A)	Output Power (W)
1500 RPM	110 V	1.2 A	132 W
2000 RPM	150 V	1.5 A	225 W
2500 RPM	190 V	1.8 A	342 W
3000 RPM	220 V	2.0 A	440 W

From the above observations, it is clear that the electrical output increases with the increase in engine speed.

1. Performance Analysis

The testing results show that:

- The system successfully converts mechanical energy into electrical energy.
- Higher engine speed results in higher electrical output voltage and power.
- The belt and pulley system effectively

transfers mechanical power from the engine to the generator.

- The generated electricity can be used to operate small electrical appliances and lighting systems.

The system performed reliably under normal operating conditions.

2. Advantages Observed

During testing, the following advantages were observed:

- Simple and low-cost power generation system
- Uses easily available two-wheeler components
- Portable and easy to operate
- Suitable for small-scale electricity generation

VIII. CONCLUSION

The main objective of this project was to design and develop a system that converts mechanical energy produced by a two-wheeler engine into electrical energy using a generator. The project successfully demonstrates the practical application of mechanical-to-electrical energy conversion using easily available vehicle components.

In this system, the two-wheeler engine acts as the prime mover and produces mechanical energy through the combustion of fuel. The rotational motion of the engine crankshaft is transmitted to the generator through a belt and pulley system or direct coupling. The generator then converts this mechanical energy into electrical energy based on the principle of electromagnetic induction.

The design and fabrication of the machine were carried out by integrating various mechanical and electrical components such as the engine, generator, frame structure, transmission system, and measuring instruments. Proper alignment and stable mounting of components ensured smooth operation of the system.

The experimental testing confirmed that the generator produced electrical output when the

engine was running at a stable speed. The voltage and power output increased with an increase in engine speed, which proves that the mechanical energy generated by the engine can effectively be converted into electrical energy.

This project provides a simple, economical, and portable solution for small-scale electricity generation. It can be useful in rural areas, workshops, construction sites, and emergency situations where electricity supply is limited or unavailable.

In conclusion, the project successfully demonstrates that a two-wheeler engine can be used as a power source to generate electricity. With further improvements in design and efficiency, this system can be developed into a practical alternative power generation method for small applications.

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