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Harnessing Electricity From Hybrid Green Gym

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Abstract- The continuous growth in population, urbanization, and technological advancement has resulted in a rapid increase in electrical energy demand. Conventional energy sources are not only limited but also responsible for environmental pollution. At the same time, a significant amount of human mechanical energy generated during physical activities such as gym workouts is wasted without any productive use. This research paper presents the concept of Harnessing Electricity from a Hybrid Green Gym, where human effort and solar energy are combined to generate electrical power. Mechanical energy produced during pedalling is converted into electrical energy using a generator, while solar energy acts as an additional and reliable source. The generated energy is stored in a battery system and can be used to operate small electrical loads. The proposed hybrid system ensures power availability during grid failures, power cuts, and environmental calamities. The system is eco-friendly, cost-effective, and suitable for decentralized energy generation. It also promotes physical fitness along with energy conservation.

Keywords – Hybrid Green Gym, Human Power Generation, Renewable Energy, Solar Energy, Battery Storage, Sustainable Powerservation and sustainability.

I. INTRODUCTION

Electrical energy is one of the most important requirements for the development of modern society. With increasing industrialization and modernization, the demand for electricity is rising continuously. Most of the current power generation systems depend on conventional energy sources such as coal, oil, and natural gas, which are limited in availability and Renewable energy sources such as solar, wind, and hydro power provide cleaner alternatives, but their availability depends on natural conditions. In addition to these sources, human mechanical energy is an easily available yet underutilized form of renewable energy. Every day, a large amount of energy is produced by people during physical activities like walking, cycling, and gym workouts, but this energy is generally wasted.

The concept of a Green Gym focuses on utilizing human effort to generate electrical energy while promoting health and fitness. By integrating solar energy with human power, a Hybrid Green Gym system can be developed to improve reliability and efficiency. Such a system can generate electricity for small-scale applications and provide emergency power during power cuts and natural disasters. This approach supports sustainable development while creating awareness about energy conservation.

II. PROBLEM STATEMENT

Human mechanical energy generated during physical activities is wasted, and reliable electricity is not available during power cuts and environmental calamities.

III. OBJECTIVES

The objectives of the proposed Hybrid Green Gym project are as follows:

1. To utilize human mechanical energy for electrical power generation
2. To integrate solar energy for hybrid and continuous operation
3. To store the generated energy using a battery system
4. To provide emergency power during power failures and calamities
5. To promote renewable energy usage and energy conservation

To develop a simple, low-cost, and eco- friendly energy solution

IV. LITERATURE SURVEY

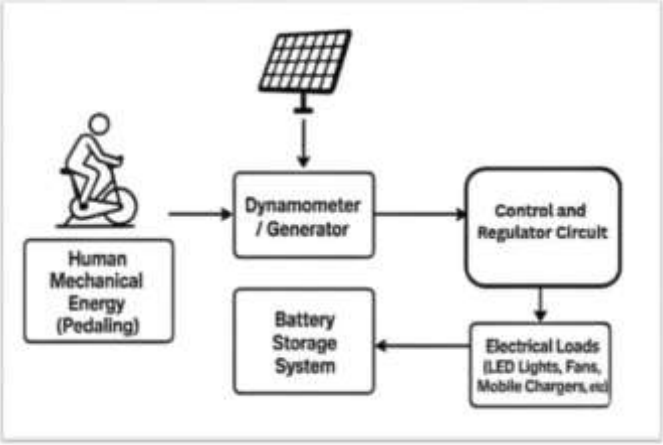
In recent years, the use of renewable and alternative energy sources has increased due to rising energy demand and environmental concerns. Researchers have explored different methods of generating electricity from non-conventional sources such as solar, wind, hydro, and human power.

Several studies have shown that bicycle- based generators can convert mechanical energy from pedaling into electrical energy. These systems are simple, low-cost, and useful for small applications like lighting and mobile charging. However, the power generated depends on human effort and cannot be maintained continuously.

Solar energy is another widely used renewable source. Solar photovoltaic panels convert sunlight into electrical energy that can be stored in batteries. Although solar power is clean and renewable, its performance depends on sunlight availability and weather conditions.

To overcome these limitations, hybrid energy systems combining multiple sources have been proposed. By integrating human power with solar energy and battery storage, such systems can provide more reliable and continuous power. This research focuses on developing a Hybrid Green Gym system that combines both energy sources to generate and store electrical energy for practical use.

DIAGRAM



V. SYSTEM DESIGN

The proposed system consists of two main subsystems: a solar energy generation unit and a canteen waste heat recovery unit. The solar unit employs photovoltaic panels to convert solar radiation into electrical energy. The waste heat recovery unit utilizes a thermoelectric generator attached to a heat collection chamber containing biodegradable canteen waste. Heat sinks maintain temperature difference across the TEG to enable power generation

VI. WORKING PRINCIPLE

The working principle of the Hybrid Green Gym system is based on the conversion of mechanical and solar energy into electrical energy, followed by energy storage. When the user pedals the bicycle, mechanical energy generated by muscular effort rotates the generator shaft. This rotation produces electrical energy at the generator output.

Simultaneously, the solar panel converts solar radiation into electrical energy using the photovoltaic effect. The outputs from both the human-powered generator and the solar panel are fed into a charge controller. The charge controller regulates the electrical parameters and prevents overcharging or deep discharging of the battery.

The battery stores the generated electrical energy and supplies power to the connected loads whenever required. During power cuts or emergency situations, the stored energy can be used as a backup power source. The hybrid operation ensures better reliability, continuous power availability, and efficient utilization of renewable energy sources.

VII. ADVANTAGES AND APPLICATIONS

Advantages

1. Utilizes renewable and clean energy sources
2. Reduces wastage of human mechanical energy
3. Provides backup power during power cuts
4. Environment-friendly and pollution-free
5. Simple design with low maintenance cost
6. Promotes health, fitness, and energy awareness

Applications

1. Gyms and fitness centers
2. Educational institutions and colleges
3. Public parks and recreational areas
4. Rural and remote locations
5. Emergency power supply during environmental calamities

VIII. FUTURE SCOPE

The Hybrid Green Gym system can be further enhanced by improving the efficiency of the generator and increasing the battery storage capacity to store more electrical energy. The use of advanced charge controllers and power electronic devices can help in better regulation of voltage and current, thereby improving overall system performance and battery life.

In the future, the system can be implemented in commercial gyms, educational institutions, and public places to promote sustainable energy generation. Real-time monitoring using IoT-based systems can be introduced to display energy generation and consumption data, creating awareness among users. Additionally, grid integration through suitable inverters can be explored to utilize surplus energy and improve system reliability.

IX. RESULTS AND DISCUSSION

The Hybrid Green Gym system successfully generates electrical energy using human effort along with solar power. During pedalling, electrical energy is produced and stored in a 12 V battery through a charge controller. The addition of a solar panel improves system reliability and supports battery charging during daylight hours.

The stored energy is sufficient to operate small electrical loads such as LED lights and mobile chargers. The hybrid approach ensures better performance compared to single-source systems and provides backup power during power cuts and emergency situations. The results indicate that the system is suitable for small-scale and decentralized energy applications.

X. CONCLUSION

This research paper presents a Hybrid Green Gym system that efficiently converts human mechanical energy and solar energy into electrical power. The proposed system demonstrates a practical and sustainable approach to energy generation while promoting physical fitness and environmental awareness. By integrating human effort with solar energy and battery storage, the system ensures reliable power availability during normal conditions as well as emergencies.

The Hybrid Green Gym concept is suitable for decentralized energy generation and small-scale applications. It offers an eco-friendly, low-cost solution that supports sustainable development and energy conservation. The results indicate that such systems can play a valuable role in addressing energy challenges at a local level.

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