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Tidal, Solar and Wind Energy Power Generation

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ABSTRACT: There are many power generating methods available in our nation to meet the power needs. But the resources used to generate are almost fossil fuels and non-renewable energy resources. Some other power generating methods utilizes the renewable sources to produce electric power. Tidal energy is a form of energy that can be utilized to produce electric power but there is no equipment or machine to utilize the tidal energy and to convert into a useful form of energy our ultimate aim is to design a machine that utilize the tidal energy to produce electric energy. Some of the renewable energy resources are not available at all time ,solar energy is also a renewable energy but it is not available at all times during nights and windy, rainy seasons the availability of sunlight is very less. But tidal energy is constant at all times so the usage of tidal energy can pave way for constant energy generation. Our machine is designed to utilize the tidal energy and also the solar energy to produce electric power. If any one input energy source is very low then the power generation also gets reduced in its rate but it never stops completely. Our machine is designed such that it can be engaged and disengaged the transfer of machine from one place to another is easy that means the machine is portable. Number of fans used to produce power is more than two to ensure the complete utilization of the tidal energy resource. Keywords Tidal energy, wind energy, solar panel ,air velocity, rotary motion.

I. INTRODUCTION

Electric power used by the people is always increasing due to the increase in population, hence power generation methods must be capable of producing sufficient power. Extraction of power from fossil fuels and some other non-renewable resources are just a temporary solution made to meet the need of electricity. When renewable sources are used as source for power generation, the method is permanent and it is preferable than the power producing by non-renewable sources. Tidal energy and solar energy are some of the renewable energy sources which can be utilized for power generation. Solar energy is almost utilized by the usage of solar panels and some other applications that produces the necessary from sunlight. Sometimes the level of sunlight may vary during bad weather conditions such as rainy, cloudy and much more seasons, but tidal energy is constant without any variation. A combination of windmill and a solar panel is our design. The designation of our project is to produce electric power from the renewable energy sources. There are many power generating methods which produces electricity from renewable energy sources, but the tidal energy are almost not utilized properly, our design will be helpful to utilize the tidal energy to produce the required current or electricity.

II. LITERATURE REVIEW

India is a country which is surrounded by water on its three sides and land on one side. This explains that a large number of beaches available in India. The utilization of tidal energy must be done to increase the rate of power production from renewable energy resources. As the number of available beaches is more than the tidal energy source is also more, therefore the proper utilization of available tidal energy will lead a way to meet the power requirement. [1]. They focused on developing a cost-effective and reliable hybrid energy solution for remote coastal regions. The research proposed a system that combines photovoltaic (PV) solar panels with diesel generators to address the electricity needs of areas that are not connected to the main power grid. The PV system serves as the primary source of energy, while diesel generators act as a backup to ensure continuous power supply during periods of low solar radiation or high energy demand. [2] They explored the feasibility and advantages of harnessing wind energy off the coast of California. The study not only assessed the abundant offshore wind resources in the region but also examined the complementary potential of integrating tidal energy to form a hybrid renewable system. The researchers emphasized that combining wind and tidal energy could offer a more stable and balanced power supply by offsetting the variability

of wind with the predictability of tidal flows. They suggested that such hybrid models could be particularly effective in managing peak energy demands and ensuring grid stability. The findings support the development of offshore renewable energy infrastructures that are both efficient and resilient, contributing to California's clean energy goals and reducing reliance on fossil fuels. [3] They focused on evaluating the technical and economic performance of a hybrid energy system combining solar and wind power. While the original study did not incorporate tidal energy, its comprehensive methodology—covering aspects such as resource assessment, load analysis, system sizing, and cost optimization—provided a strong framework that was later adapted for more complex hybrid systems involving a third source, such as tidal energy. The study demonstrated how to balance renewable inputs to ensure reliable power supply while minimizing overall system costs. By using simulation tools and economic evaluation metrics like the levelized cost of energy (LCOE), the research offered valuable insights into hybrid system design and implementation. Its methodological foundation has been widely referenced and extended in subsequent studies that aim to integrate tidal energy into multi-source renewable systems, highlighting the versatility and relevance of the original approach.

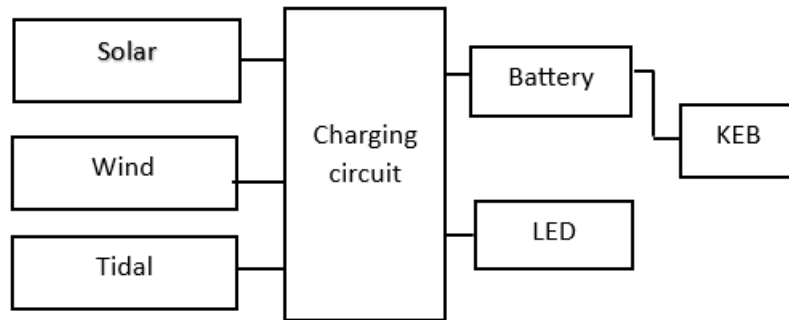
III. PROPOSED SYSTEM

It operates efficiently because it utilizes multiple renewable energy sources that complement one another. During the daytime, the solar panel provides the primary source of power, while during windy or cloudy conditions, the wind turbine ensures continued power generation. Additionally, the tidal energy system produces power consistently based on the predictable movement of tides, thus compensating for periods when both solar and wind power might be insufficient. This combination provides a continuous and balanced supply of energy throughout the day and across different seasons. It demonstrates how integrating multiple renewable energy technologies can overcome the limitations of individual sources, provide continuous power, and reduce dependency on non-renewable energy. The system also promotes environmental protection by minimizing carbon emissions and supports the vision of green and renewable energy utilization for future applications.

IV. METHODOLOGY AND WORKING

The working principle of the hybrid renewable energy system integrating tidal, solar, and wind energy sources with a charging circuit, battery, and LED load is based on the combined operation of multiple energy conversion and power conditioning processes to achieve efficient and continuous electricity generation. In this system, the solar photovoltaic (PV) module converts solar irradiance into direct current (DC) electrical energy using the photovoltaic effect, where incident photons excite electrons within the semiconductor material,

producing a potential difference. The wind turbine generator (WTG) converts the kinetic energy of moving air into rotational mechanical energy, which drives a generator—commonly a permanent magnet synchronous generator (PMSG) or DC generator—to produce electrical power. Simultaneously, the tidal energy conversion unit harnesses the hydro-kinetic energy of ocean tides; the flow of water during high and low tides rotates submerged turbine blades mechanically coupled to a generator, resulting in DC power output. The electrical outputs from these three renewable sources are directed to a power conditioning and charging circuit, which performs rectification, voltage regulation, current control, and load balancing. This circuit ensures proper DC bus stabilization, maintains constant voltage levels, and prevents backflow of current to the generators through blocking diodes or charge controllers. The energy storage subsystem, typically a lithium-ion or lead-acid battery, stores excess energy during peak generation periods and supplies power during low generation intervals, ensuring system reliability and continuous operation. The charging circuit continuously monitors the state of charge (SOC) and state of health (SOH) of the battery to avoid overcharging and deep discharging conditions. The stored DC power is then supplied to the LED (Light Emitting Diode) load, which operates on the electroluminescence principle, converting electrical energy directly into visible light with high luminous efficacy and low thermal losses. The hybrid operation ensures maximum power point utilization (MPPT), energy stability, and power quality enhancement by compensating for the intermittency of individual renewable sources. This integrated system provides a sustainable, efficient, and reliable power generation solution suitable for both standalone and grid-assisted applications.



The implementation of a hybrid renewable energy system produces significant and measurable results, demonstrating the effectiveness and practicality of sustainable power solutions. By integrating multiple renewable sources, the system overcomes the intermittent nature of individual energy types, ensuring a more consistent and reliable electricity supply. Solar energy provides power during daylight hours, wind energy contributes during periods of adequate wind, and tidal energy offers a highly predictable source based on tidal cycles. The charging circuit plays a critical role in managing the flow of electricity from these sources, regulating voltage and current to prevent overcharging and energy wastage, thereby optimizing the storage efficiency in batteries. Batteries store surplus energy generated during peak production periods and supply electricity when generation is low or absent, ensuring uninterrupted power availability for LED lighting and other low-power applications. The use of LEDs enhances energy efficiency, as they consume minimal power while providing sufficient illumination, maximizing the utilization of harvested renewable energy. Experimental implementation of such hybrid systems typically demonstrates a substantial reduction in dependency on conventional grid electricity, leading to cost savings and enhanced energy security. Additionally, these systems contribute positively to environmental sustainability by reducing greenhouse gas emissions and minimizing the ecological footprint associated with fossil fuel-based energy generation. From a performance perspective, the results indicate that the hybrid system can maintain a stable voltage and current supply to connected loads, even under variable environmental conditions, proving its robustness and reliability. Furthermore, the modular nature of the system allows for easy scalability, making it suitable for rural, off-grid, and coastal communities where conventional electricity access is limited. Overall, the project results confirm that combining tidal, solar, and wind energy with efficient charging circuits, battery storage, and LED loads creates a sustainable, reliable, and environmentally friendly energy solution with significant potential for future adoption and expansion.

V. FUTURE SCOPE

The future scope of this systems is highly promising, reflecting the global shift toward sustainable and decentralized energy solutions. Each of these renewable sources has unique characteristics: solar energy is abundant during daylight, wind energy can be harnessed whenever wind speeds are sufficient, and tidal energy provides a highly predictable and reliable power source due to gravitational interactions. Integrating these sources into a single hybrid system allows for continuous and stable power generation, overcoming the intermittency issues associated with individual renewables. Charging circuits play a crucial role in efficiently regulating and managing the flow of electricity from these diverse sources, ensuring that the energy is properly stored in batteries without overcharging or energy loss. Batteries act as essential energy storage units, enabling the system to supply electricity during periods of low generation, such as nighttime or calm weather, while also providing backup power for critical applications. The inclusion of LED systems complements this setup by providing energy-efficient lighting solutions, minimizing overall power consumption, and ensuring maximum utilization of harvested energy. Looking ahead, such hybrid renewable energy systems have enormous potential for deployment in remote, rural, and off-grid communities, where conventional electricity supply is limited or unreliable. Advances in battery technology, including higher capacity, longer life, and faster charging capabilities, will make these systems more cost-effective and scalable. In addition, widespread adoption of these hybrid systems will contribute significantly to reducing greenhouse gas emissions, mitigating climate change, and achieving global energy security, positioning them as a cornerstone of future sustainable development and eco-friendly technological innovation.

VI. CONCLUSION

The implementation of such a hybrid system demonstrates reduced dependence on conventional grid electricity, cost savings over time, and improved energy security, particularly for rural, coastal, and off-grid communities. Environmentally, the system contributes significantly to reducing greenhouse gas emissions, promoting cleaner energy practices, and supporting global sustainability goals. The project also highlights the scalability and adaptability of hybrid energy systems, as additional renewable sources or storage units can be integrated based on local availability and demand. Overall, the study confirms that combining tidal, solar, and wind energy with advanced charging circuits, reliable battery storage, and energy-efficient LEDs creates a robust, eco-friendly, and sustainable power solution. The success of this hybrid approach underscores its importance as a model for future energy systems, demonstrating that renewable energy integration can meet growing energy demands while addressing environmental challenges, fostering technological innovation, and supporting the global transition toward a sustainable and resilient energy infrastructure.

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