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SUBMERSIBLE HYDRO ELECTRICITY GENERATION SYSTEM

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ABSTRACT

A submersible hydroelectricity generation system presents an innovative approach to harnessing energy from flowing water sources, such as rivers and streams. This system utilizes submersible turbine designed to operate efficiently underwater, converting kinetic energy from water flow into electrical energy, key components include a turbine, generator, and control, system all housed in a robust submersible casing to withstand aquatic conditions. The design optimizes hydrodynamic efficiency and minimizes environmental impact, allowing for installing in diverse locations, including remote and off-grid areas. The study explores various turbine configuration, energy output assessments, and scalability potential, demonstrating that this system can provide a sustainable and reliable energy source. Additionally, it addresses challenges such as maintenance, deployments, and integration with existing power grids, highlighting the role of submersible hydroelectricity system in advancing renewable energy technologies. this abstract serves as a foundation for further research and developments, aiming to the global shift towards suitable energy solutions

Keywords: Horizontal Axis Water Turbine (HAWT), Kinetic Energy, Renewable Energy, Electricity Generation.

I. INTRODUCTION

The increasing demand for alternative and renewable energy sources has become one of the most pressing global challenges as nations seek to reduce reliance on non-renewable fossil fuels, Therefore, the development of renewable energy is common trend in the current world. Study find that more than 35 percent efficiency is captured by underwater electricity generation Tidal energy offers a vast and reliable energy source. This technology is similar to wind energy technology, with the turbine driven not by wind power but by tidal current, the gravitational pull of the moon produces a swift tidal current, which spine the long blades of the turbine. which is turn produces electricity via different parts of underwater turbine. This energy derived from the moon that now helps to power a small arctic village

Rural electrification remains a critical challenge in many remote areas with limited access to grid power. One innovative solution is the deployment of submersible hydroelectricity generation system. this system harnesses the power of natural water flows, such as rivers and streams, to generate electricity. By placing turbine underwater, submersible system is less obtrusive, more environmentally integrated, and capable of continuous energy production, making them ideal for remote, off-grid areas.

II. METHODOLOGY

Submersible hydroelectric generation using horizontal turbines is a method that harnesses the kinetic energy of moving water (rivers, oceans, tidal currents, canals, etc.) to generate electricity. This method is particularly useful in underwater environments, where conventional vertical axis turbines may not be as effective due to water flow patterns. The horizontal axis turbine's design and placement allow it to efficiently capture energy from water currents while being submerged.

1. Turbine design:

Horizontal Axis Water Turbine (HAWT): The turbine blades are aligned horizontally. parallel to water flow. This setup is ideal for capturing energy from consistent. Unidirectional current in rivers or tidal flows. Blades design: The are typically shaped to maximize efficiency in converting water flow into rotational motion. This design is influenced by the flow rate and speed of the water. Submersible structure: The turbine housing and generator are designed to be fully submersible, often using corrosion-resistant material to withstand long-term exposure to water. The structure is anchored to the riverbed or ocean floor.

2. Generator:

The Turbine's rotational motion drives a generator, converting mechanical energy into electrical energy. This can be done using either direct drive or through gear systems, depending on the required speed and torque.

Low-speed direct drive generators: Often used in submersible system to eliminate the need for complex gearboxes, which may be prone to wear in underwater environments.

3. Energy Transmission:

The generated electricity is transmitted via underwater cables to the shore or to an energy Storage facility. Subsea Cables: Specialized cables designed to handle underwater conditions are used to transmit power while protecting against water ingress and mechanical damage

4. Water Flow and Site Selection:

Location: Ideal sites for submersible hydroelectric generation include areas with consistent, strong water current, such as riverbeds, tidal estuaries, and certain oceanic location. These sites provide reliable energy capture.

Flow Rate: The effectiveness of the system depends on the flow velocity and volume of water. Horizontal turbines are typically placed in locations where water movement is strongest, the power generated is proportional to the cube of the water velocity

5. Installation and Maintenance:

Anchoring: The Turbines are anchored securely to the seabed or riverbed to prevent movement or shifting. Depending on the depth and water flow, either fixed or floating anchoring systems can be used. Maintenance: Maintenance can be more challenging in underwater system due to accessibility issues, so materials and design must account for durability and ease of retrieval

III. MODELING AND ANALYSIS

When designing a system for generating electricity from submersible turbine, several key factors must be considered to ensure efficiency, feasibility, and sustainability. The design must integrate both the electrical and mechanical aspects, taking into account the materials used, PVC pipe metal stand, AC submersible motor, bearing and practical application in rural areas. Below are the crucial design considerations for implementing such a system:

Energy Input and Output: Calculate the total energy output based on the concentration of water flow in the dam or canal and the efficiency of the water to the system. Formulate the energy balance, considering the energy input (such as energy used to collect and process the submersed system) versus energy output in terms of electricity.

Cost Analysis: Perform a cost-benefit analysis, considering both capital and operational costs of setting up and running the system, as well as the market price of electricity.

a. **Design of turbine -** Designing a PVC turbine for electricity generation from submersed assembly requires careful consideration of several factors to ensure the system's efficiency, durability, and ease of operation. Below are the key design considerations:(i) Design of PVC turbine, (ii)Material Selection, (iii) Inlet and OutletDesign, (iv)Safety and Environmental Considerations, (v)Ease of Maintenance

b. **Definition of problem statement-** Rural electrification remains a critical challenge in many remote areas with limited access to grid power. Due to electric faults and constant peak demand from load the rural villages are affected the most of it. Also, renewable energy is not harnessed to its full potential. so to overcome this problem we are developing a model of hydroelectricity generation using submersible turbine.

c. **Selection of material-** Keeping in mind the low-cost requirements and the operating environmental conditions, we have to use PVC pipe, metal stand, AC submersible motor and designing of gear ratio of low cost, other materials like selection stabilizer for stable electric output.

Overall Block Diagram

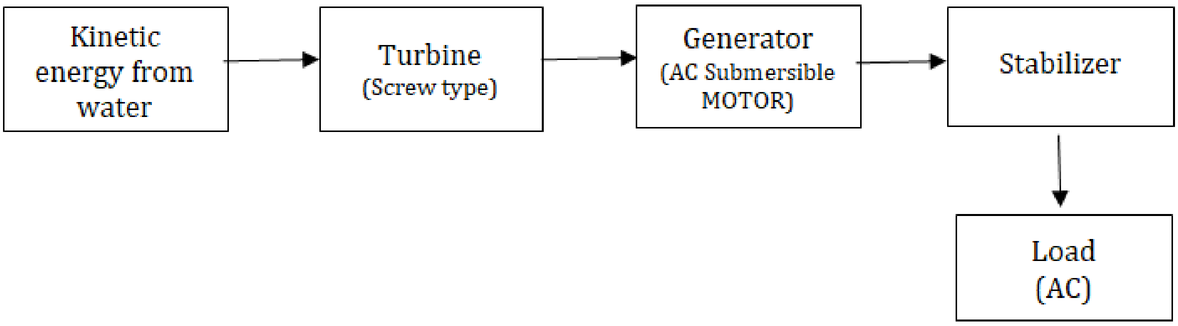

Figure 1: Block Diagram

a. **Kinetic energy:** The energy an object has because of its motion if we want to accelerate an object, then we want apply a force. Applying a force requires us to do work. After work has been done, energy has been transferred to the object and the object will be moving with new constant speed

b. **Turbine:** The most vital component for harnessing energy in this system is rotor. The turbine use in this system is horizontal axis kinetic turbine. The rotor axis is orthogonal to water flow but parallel to the water surface. This turbine consists of 7 number of curve shape. Turbine made up of PVC pipe. Turbine is a rotary mechanical device when the water strikes the blades of the turbine the blades make rotation and convert it into useful work. The work produced by a turbine can be used for generating electrical power when combine with a generator

c. **Generator:** Electrodes are placed in the urine to enable the chemical reaction. These could be metals that allow for the flow of electrons (current) when the chemical reaction occurs.

d. **Stabilizer:** Energy generated from the model is not constant because flow of water is the water is not constant at all the time of the day. It varies from season wise like at the rainy season flow of water is high as compare to the summer season. Because of that the output is also vary, the variable output affect the performance of the equipment so we need to stable the output at constant value such that it should not affect the performance of equipment so we use the stabilizer. As per requirement we select the rating of stabilizer.

e. **AC Load:** An AC (alternating current) Load refers to any electrical device or system that operates using alternating current. This type of load is characterized by the flow of electric charge that periodically reverses direction. Here's a detailed overview of AC loads

IV. RESULTS AND DISCUSSION

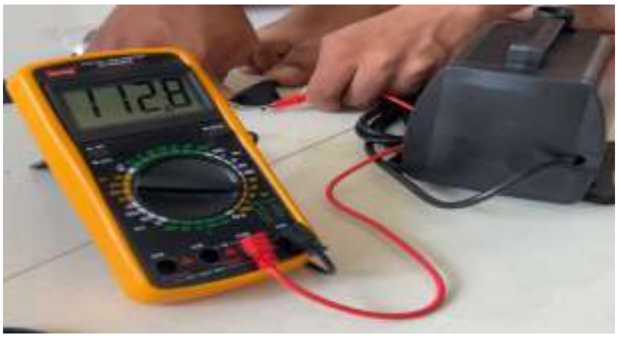

Figure 2: Motor Testing and observation

Figure 3: PVC Turbine Design

V. CONCLUSION

The study on generating electricity from submersible turbine presents a sustainable and innovative approach to hydroelectricity. By harnessing the power of water resources, the project demonstrates the potential of turning water resources into a renewable energy source. This method not only provides a feasible alternative to fossil fuels but also offers an efficient solution to uninterrupted electricity supply, particularly in rural areas. The findings highlight that the use of PVC turbine can serve as a practical tool for addressing energy shortages in regions with limited access to electricity. Additionally, the low cost and availability of materials make this approach highly scalable for small-scale rural electrification projects. Overall, this research opens the door to further exploration of water-based energy systems, reinforcing the global push for sustainable development and green energy solutions.

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