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Development of Hydroelectric Power Generation from Water Pipelines

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Abstract: ***Pico hydroelectricity is a good way to make clean energy. We're talking about making a system that gets water from the tanks in houses. The water moving through household pipes can make electricity that we can store. To make this system work even better, we've thought of some new ideas: an air bladder to keep the water pressure steady, U-tube piping, and a big nozzle pipe at the end. This system doesn't need any fuel and doesn't need much fixing to keep working. Our plan is to make a small hydro system that can use the energy stored in a water tank to make power. This power can then be used in homes for different things.***

Keywords: Renewable energy, Hydroelectricity, turbine, diaphragm pump, portable etc.

I. INTRODUCTION

Hydro-electricity works by using the power of water flowing down from a high place. This creates pressure, which is like a strong push, and this pressure helps to make energy. People have been using the energy from flowing water for a really long time, even before we had electricity. They used it to power machines and do tasks like pumping water and grinding grain. Nowadays, we use it to make electricity, which has been happening for about 100 years. The good thing about water is that it's always there, unlike wind or sunlight which can come and go. So, if we set up the right system, we can get power from water every day of the year. This has been really helpful for people in the past who needed power for things like irrigation pumps and mills, and it's still useful today for making clean energy. Here's how it works: We collect water in a tank, and then let it flow down through a pipe that's slanted downwards. As the water flows down, it turns a turbine which generates electricity. This electricity can be used right away or stored for later use, like during a blackout. The cool thing about this system is that it doesn't make your water bill go up. It's designed to use the water you already have in your tank, so you're not using any extra water. Its main purpose is to store the power it generates for later use, especially when there's no electricity. Compared to other small hydro systems, the one we're talking about doesn't make a lot of electricity, just about 8 watts. But it's still good because it's cheap, easy to use, and good for the environment. Plus, you can set it up almost anywhere without much trouble.

II. PROBLEM IDENTIFICATION

Energy is crucial for various aspects of life and economy, but we've encountered challenges like oil scarcity, worsening climate change, and insufficient electricity. Smart solutions are needed to address these issues, such as generating electricity locally using clean sources like wind, solar, tides, and moving water. Hydroelectricity, derived from flowing water, is a significant clean energy source. Turbines capture the energy of moving water and convert it into mechanical energy, which is then transformed into electricity by generators. People have utilized water power for centuries, starting with water wheels and evolving into modern hydroelectric turbines. Large hydroelectric dams currently contribute about 16% of global electricity, although they can negatively impact the environment by requiring extensive land and altering water flow

III. EXPERIMENTAL WORKING

Water storage tanks are placed at particular heights to replicate residential structures. First, we need to take into account residential structures like apartments and villas, which are densely occupied by many people in a little space. The initial water tank constructed within residential buildings will be of significant capacity. The maximum flow rate is then attained when the volume rises. The morning hours from five in the morning to ten in the morning are when residential buildings like apartments will use the most water. For the duration of this time, practically everyone will be using one or more water sources for cooking, bathing, or washing purposes. Since water is being continuously consumed, we reach our maximum flow rate at this time. Every day before the start of consumption time, the water tank needs to be filled so that water pressure and head are both maintained.

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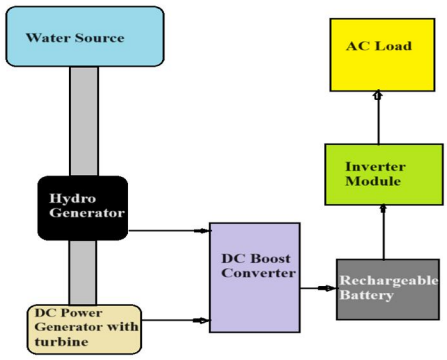

Fig.1: Block Diagram

Following are the working of total system;

1) Three hydro turbine generators are installed in the pipe, and they operate when water flows from the pipe at a specified height. At output, whole water is discharged is fall on big hydro turbine generator, forcing water flow in one direction, causing turbine generator to start rotating, and producing energy. A generator begins to run and generate power when water is used to rotate a turbine.

2) Through increase the dc voltage, the entire electric energy is sent through a DC to DC boost converter. Additionally, it goes via a unidirectional current controller before being stored in a battery. A control board with an LCD display uses a controller. The output voltage is measured using this control board.

3) A further inverter board is utilized to change the voltage from DC to AC. Finally, an AC load is connected at the output.

4) By doing so, the pipeline work will use a prototype hydro power generation model.

IV. COMPONENTS SPECIFICATION

A. DC Generator

The most effective way to utilize the mechanical energy generated by a pico-hydro system is by powering a DC generator with a powerful magnet. High currents could be provided by a DC generator even at the lowest voltage needed for battery replacement and the operation of direct current loads. They are also significantly less expensive and smaller in size. Since no power is lost creating the magnetic field, this sort of generator is said to be more efficient.


Fig.2: DC Generator

B. Hydro Turbine Module

A water turbine spins around and uses the energy from moving water to do work. When water flows onto the turbine's blades, it pushes them, making the turbine rotate. This lets the turbine take the energy from the water flow and use it to do mechanical work.


Fig.3: Hydro Turbine Module

C. 12V Battery

In order to store the electricity generated by solar and wind energy, batteries are employed. The size of the solar or wind power plant may have an impact on the battery's capacity. Low charge leakage and low maintenance should be characteristics of the battery. The optimum option is the free discharge kind when all these factors are taken into account. Depending on the output from the hybrid systems, multiple batteries can be linked in both series and parallel to enhance or decrease the battery's capacity.

Fig.4: 12V Battery

D. DC to DC Boost Converter

A boost converter, also known as a step-up converter, is a DC-to-DC power converter that increases voltage from its input (supply) to its output (load) while reducing current. This type of switched-mode power supply (SMPS) has at least two semiconductors (a diode and a transistor) and at least one energy storage component, such as a capacitor, inductor, or both. Filters built of capacitors are typically added to such a converter's input (supply-side filter) and output (load-side filter) in order to eliminate voltage ripple.

Fig.5: DC to DC Boost Converter

E. Light-Emitting Diode (Led)

The anode (+) is the longer lead, and the cathode (&minus) is the shorter lead. The anode is on the left and the cathode is on the right in the schematic symbol for an LED (bottom). LEDs are components used in electronics for light signalization.

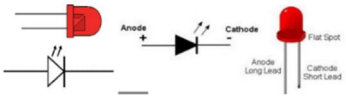

Fig.6: Light-Emitting Diode (Led)

F. Micro Hydropower Generator (12V 10W)

A micro hydropower system needs a turbine, pump, or waterwheel to transform the energy of flowing water into rotational energy, which is converted into electricity.

Fig.7: Micro Hydro Power Generator (12V 10W)

V. CALCULATION

Power Generation in a micro hydro system, the head and the flow of the water in a river or stream define its power potential. One can calculate the potential power as follows:

$$P = Flow\ rate(Q) \times Head(H) \times Gravity(g) \quad (2.1)$$

$Where$

$P = Power\ (W)$

$H = Head\ (m)$

$Q = Water\ flow\ (m3/sec)$

$g = gravity\ constant\ (9.81\ Newton)$

When the water pours out of the pipeline and falls over the head, this potential energy will be converted into kinetic energy. This kinetic energy is a form of pressure that causes the hydraulic turbine's shaft to rotate. The synchronous generator will then be powered by the mechanical energy from the turbine to generate alternating current (AC) electricity. The distribution of the electricity to homes will follow. For the AC power source to reliably power any electrical equipment using it, it must be kept at a steady 50 or 60 cycles per second. The speed of the turbine, which needs to be extremely precisely managed, determines this frequency. The ideal geographic regions for using micro-hydro power are those with steep rivers that flow all year round, such the hilly regions, the hill areas of countries with high year-round rainfall, or the great mountain ranges and their foothills.

VI. ADVANTAGES

1) It Generates clean energy without harming the environment (it has no negative environmental effects).
2) It does not depend on weather conditions like solar and wind systems do.
3) It has no impact on the quality of water for drinking purposes.
4) It is one of the least expensive ways to generate electricity (as opposed to solar and wind, which cost three or four times as much to generate the same amount of energy).
5) It can also be put in wastewater, agricultural, and industrial pipelines.
6) Water flow can be used to continuously generate electricity.
7) Simple installation
8) Recovers energy from processes.

VII. FUTURE SCOPE

1) Making electricity doesn't create any carbon emissions.
2) Electricity is made without needing coal or oil. This helps natural resources last longer.
3) It can reduce how much electricity each person uses, so everyone can have power.
4) It's safer than nuclear power and fossil fuels. Those methods use chemicals that can cause health problems if people are exposed to them often.

So, using this cleaner way to make electricity is better for the environment and our health. It's also important because it means we don't need to depend on things like coal and oil, which can run out and harm the environment.

VIII. CONCLUSION

We want to make a small hydro system that uses water from houses' water tanks to make energy. This could be a good and eco-friendly way to make energy and help grow small hydro power. It's a very flexible way to make power that can give AC electricity even in faraway places where there's not much power. So, by using this system, we can make electricity in a way that's good for the environment and helps people who live in places without much power. This is important because it helps us use natural resources wisely and brings electricity to places where it's hard to get. We're excited about the potential of this system to provide clean and accessible energy to communities around the world, especially in remote areas where electricity is scarce.

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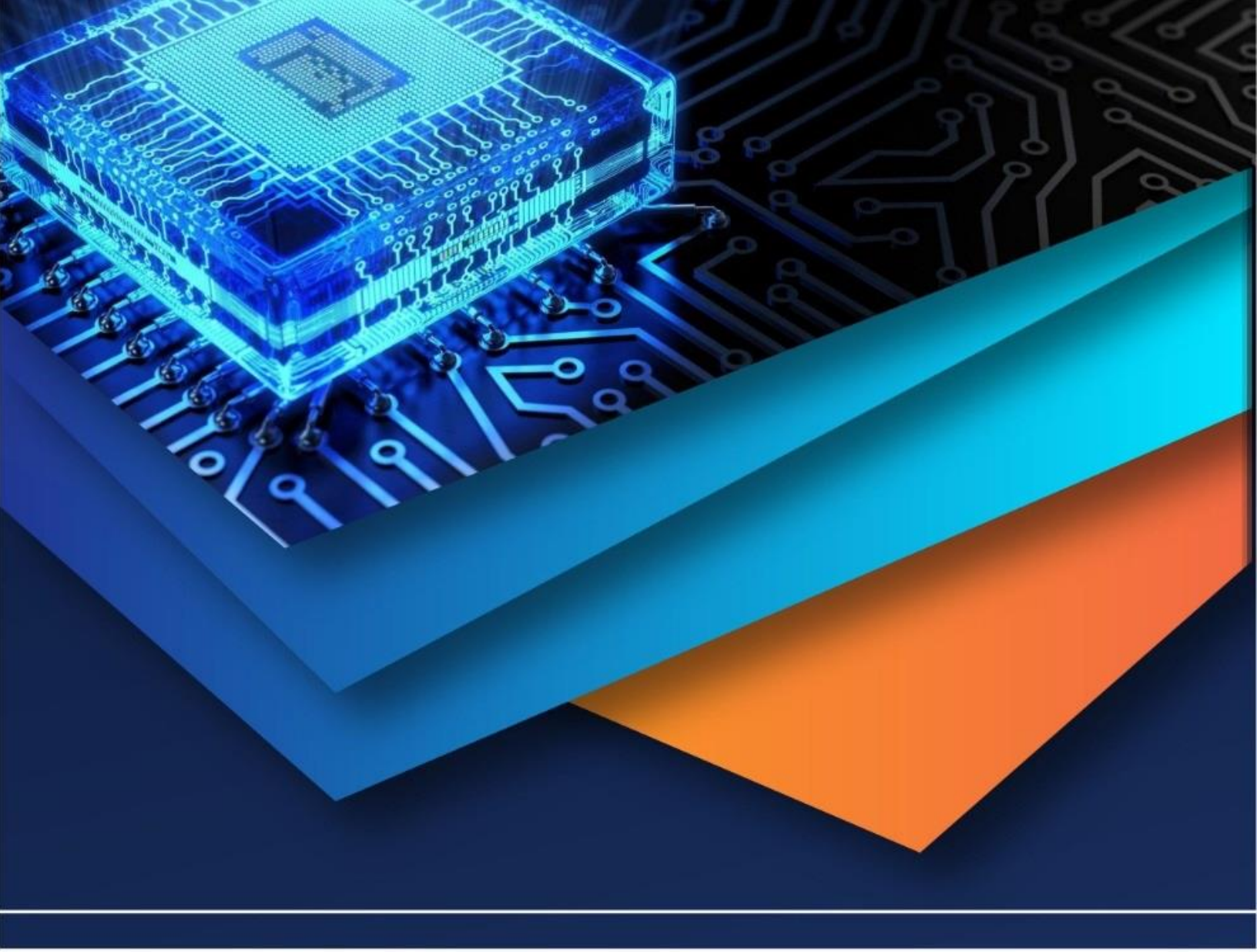

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