ELECTRIC PIPE GENERATOR

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Pipes – Hydropower – Turbine Generator –Kinetic Energy – Electricity

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Abstract

Egypt suffers from serious energy problems which can`t be solved using the traditional ways. So, the solution is to increasing the use of alternative and clean energy sources. Increasing the use of alternative energy isn't enough; technology and communication had to be involved. Between all the fabulous alternative energy sources water kinetic energy is a source which is sustainable. One source for this energy is the water flow in domestic buildings pipes. Water movement in the building pipes creates untapped kinetic energy. Using a water turbine generator to turn the kinetic energy from water movement automatically to electricity can be exploited by collecting them in the battery to be a backup source in the case of a power outage, towers will be self-producing electricity and reduce constantly overload on the power station. The test plan was done by following scientific steps which are product analysis, design test strategy, document risk and issues, and collecting data. After the test plan data and results were collected and they were promising. Electricity is produced, collected, and distributed successfully. Chosen Design requirements efficiency, low cost, and applicability were achieved too.

introduction

The energy problem is one of the most important grand challenges that face Egypt therefore the old ways of generating energy are not enough to solve it. Knowing the importance of energy for the aim of the country developing new ways to come over the problem of energy production becomes a need. One way to achieve this is by using alternative energy resources hand in hand with technology. The field of generating energy has been working at its maximum capacity to find alternative sources for energy and their efforts paid off by finding efficient alternatives. some of them are:

1-Magnetic energy generator: Is used to generate and dispense electrical energy. It is a system with an organized structural arrangement of permanent magnets, bifilar coils, and a PCB controller with specially designed software that is used to generate and dispense electrical energy. Its most important strength point is that as long as the magnetic field is operational and the rotor is moving, the magnetic power generator is generating electricity. But the problem is that they are difficult to make.

2- **The biomass power plant:** generates electricity and heat. The biomass power plant consists of a wood gasifier and a combined heat and power unit. The gasification of waste reduces the need for landfill space, decreases methane emissions, and reduces the use of fossil fuels beside generating energy making it an efficient solution. But the gasifier can turn inefficient under high uniform temperatures and may become impractical for power ranges above 350 kW.

In our project, we are going to put a water turbine generator on the high residential buildings at Gharb Qena new city water-feeding pipes. The idea of the project is to make use of the continuous water flow due to household usage of water which generates kinetic energy to generate electricity and store it to be used later as a backup source of electricity when there is a power shortage. Our project is based on the scientific base of hydropower plants which is that the water flow generates kinetic energy which is used to make the pleads of the turbine spin utilizing the generator to generate electricity (figure 1).

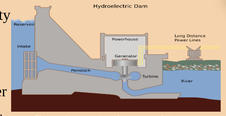


Figure 1hydroelectric dam which uses turbine to generate electricity

The project design requirements are efficiency, low cost and applicability which are achieved as the efficiency for the generation part is 20.25% and for the distribution part is 98 %.

Materials and Methods

Materials:

Methods:

1. First, we typed down the codes for both the voltage and the water flow sensors.
2. Next, we connected the water flow sensor with the ¾ inch pipe then we connected it with a pipe that has two sides one side is ¾ inch and the second one is ½ inch. The ½ inch side of the pipe was connected with the water turbine generator and then the water turbine generator was connected with a pipe ½ inch from the other side as shown in (figure 2)
3. After connecting the main parts of the prototype, we started to connect the sensors to the Arduino and the breadboard. For the water flow sensor wires we connected the:
   - Red wire (VCC): with the 30 positive rail of the breadboard
   - Black wire (GND): pin at the Arduino board.
   - The yellow wire (output data): with 1J at the breadboard.
4. Then we connected digital pin 2 of the Arduino to 1I at the breadboard, the 5V pin at the Arduino board to the 18 positive rail of the breadboard, and the first positive rail of the breadboard to 1D at the breadboard as shown in the opposite figure (diagram1).
5. The next step was to make the switching circuit and connect it to the battery and the water turbine generator. The first step was to draw a diagram for the circuit to find the suitable components and after having the suitable circuit we draw it on the proteus app (diagram2) to test if it works and it did work.
6. The second and final step is to put the components of the circuit on the stripboard using the diagram we drew that is shown in (diagram2).

Figure 2 final look of the prototype when the pipes are connected

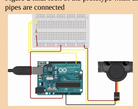


Diagram 1 interfacing Arduino with water flow sensor

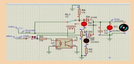


Diagram 2 a diagram for the circuit on proteus

Test plan

After we finished from constructing our prototype and writing the codes it's time to test them and in order to test them, we followed the following steps:

First test plan: We connected the prototype to a water source and to connect the voltage sensor to the water turbine generator. Afterward, we started to change the amount of water that enters the prototype to see how much will the magnitude of the produced energy vary with the change of water speed.

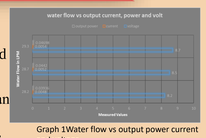
Second test plan: We connected the circuit to the led and the battery then we connected them to the generator after this we disconnected the battery and as soon as we did this the system switched to the generator and when we reconnected it the system again returned to the battery as a main source.

Results

After we finished constructing the prototype we tested it. Indeed, not all tests were promising that some mistakes led to undesirable results which are:

1. The code didn't run accurately which make the test plan fail.
2. The water speed was too slow that there was no power generated.

After solving those problems test plan was successfully done with all promising results that are illustrated in the following graphs and table.



Graph 1Water flow vs output power current and voltage

Trials	Water flow Liter/min	Water flow m^3/sec	Current *I*	Volt *v*	Efficiency	Output power Watt/sec
Trial 1	28.2	.00047±0.05	.0048±2	8.2±0.5	19.01%	0.03936±2.5
Trial 2	28.7	.000478±0.05	.0052±2	8.5±0.5	20.2%	0.0442±2.5
Trial 3	29.3	.00488±0.05	.0054±2	8.7±0.5	20.25%	0.04698±2.5

Table 1: results and error percent

Analysis

As energy problems can be considered one of the most critical problems facing Egypt, causing economic, health and educational issues, so it should be solved for the sake of the country. Improving the use of alternative energy using technology was our challenge for this year. The solution we chose to proceed with was putting a water turbine generator on the water feeding pipes of the residential buildings. Studying gravity and mass at (PH.1.04) helped us determine the place the turbine must be put on, and we decided to put it in the bottom of the pipes as the water pressure is at its highest value there which will give is higher amount of electricity. The project's main idea is to have an alternative sustainable source for energy that can be used in case of power shortage to light up small devices and lights. We decided to apply an automatic switching system that will change between the main power source and the electricity generated from the turbines. And for the project to be an effective solution, we decided to implement it at Gharb Qena new city and studying GPS at (ES.3.02) had helped us to determine the places of towers and new cities to apply our projects on a large scale.

The main part of the project is the water turbine, and for it, we chose to work with a cross-flow turbine that depends on magnetic field and as we faraday's law at (PH.2.08) that helped us to understand the mechanism of it**.** Next is the power switching system, and for it,

we chose to work with a relay that will be responsible for switching the power automatically when it detects that there is a power shortage. And for the body of the prototype, we chose to work with PVC pipes as they are the commonly used type of pipes. Working with those parts will help us to achieve the design requirements, which are:

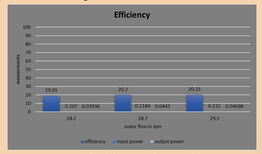
Low Cost: for this design requirement to be tested, we calculated the sum of the cost of the materials we used, and it came up to be 662 which is a low cost compared to the used material.

Applicability: By choosing to work on PVC pipes similar to those used in domestic buildings and using the water from the house tape without a bump, we ensured that the circumstances were the same as those for the real solution.

Efficiency: For this design requirement to be tested, we measured the input and the output, and as we studied at (PH.2.04), the power-law helped us to calculate the amount of the output energy.

Then taking the results of output and input power, we used the law to calculate the efficiency of generating and the results are shown in the opposite graph (graph2)

As our prototype consists of two parts, we calculated the efficiency for the second part which is distribution using the law:

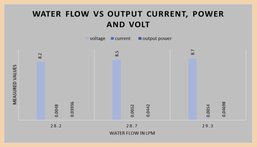


graph 2efficiency of generated power

distribution efficiency $= \frac{p\ input - p\ R}{p\ input} \times 100$ where the $pR = I\text{^}2 \times R$ taking the results for the 28.7 LPM water flow the efficiency was 98%.

Working on the previous design requirements and materials helped us to draw the following results.(graph3)

And as no measurements are perfectly accurate, there was an error percentage, and studying accuracy, precision, and uncertainty at (CH.3.02) helped us differentiate between test plan results and determine our error percentage.



graph3 results

Conclusion

After following all required steps to complete test plans some results were promising and the others weren't. The successful test plans had a promising result; a voltage was produced, all the circuit was correctly connected, and all resistors were put in the right order; that's why power was collected and distributed successfully so, lamps were turned on without problems. The prototype produced (0.04698) watt/sec with an average efficiency of 20.25% and average efficiency of 98 % for the distribution; voltage amount was measured by voltage sensor so, the results were more accurate. The prototype efficiency was great whither voltage production was stunning, and low cost was achieved the project cost is lower than the solutions applied before. So, the project achieved all the chosen design requirements spectacularly.

Recommendation

Indeed, no project is free of mistakes, errors, and better recommendations. Thus, some adjustment are recommended hope leading to better results.

1. Higher buddings are more efficient in this project whither higher buildings where more people consume more water, and because of the continuous flow of water in the pipes, they generate more energy.
2. Based on Bernoulli's principal water goes faster in a narrow pipe, so, putting a turbine in a narrow pipe where the water goes faster.
3. Increasing the surface area by using a turbine with a wide and bigger fan blade is more efficient and rotate faster than a smaller one.

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