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Renewable Energy Based Radio Phone Charger

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***Abstract* |** *Most of the part in the world is not having access to electricity. The commodity of communication requires a user to have access to at least a battery. This problem of lack of access to electricity is faced by the military when working on the field for a particular operation. The ability to connect to the base station is through a radio phone. However, when working in hilly terrains and rain forests access to common methods of renewable energy such as solar, wind, etc. is not possible. This problem should be solved using some other available resources in rain forests.*

This project aimed is to develop an energy harvester that is compact and sufficient enough to power a radio phone for at least 40% charge. This problem is being solved using the very old method of electromagnetic induction and using the stored charge to power up the radio phone. The potential energy of rainwater will be used as a power source. The potential energy will be converted to kinetic energy and the kinetic energy is converted to electric energy.

The problem will be solved by combining mechanical, electrical & electronics components. The simulation and testing will be done on MATLAB software.

1. INTRODUCTION

Recent Technological advance in the field of energy harvesting has a great impact on the economic as well as human growth in developed. So this project is aimed to develop a renewable energy based radio phone charger for military applications in Rain Forest areas. Mainly its aim is to develop an energy harvester that is compact and sufficient enough to power a radio phone for at least 40% charge. The potential energy of rainwater will be used as a power source. The problem will be solved by combining mechanical, electrical & electronics components. The simulation and testing will be done on MATLAB software (Version-R2013A).

The task is based on utilizing Hydroelectricity at small scale. The challenge is to obtain electricity at 3.3V DC output. The various mechanisms used were to mesh gears to constitute a constant Torque providing mechanism. The electricity will be produced using a generator and corresponding generated voltage be stepped down to 3.3V. The reason being the battery of a Radio phone accepts 3.3V DC input voltage. The discharging should not take place while the phone is getting charged.

For this research, I choose MATLAB and SIMULINK as the software to create this project simulation. This can also be achieved by using Scilab and LabVIEW simulation software.

2. WORKING PRINCIPLE

To generate electricity, water must be in motion. This is kinetic (moving) energy. When flowing water turns blades in a turbine, the form is changed to mechanical (machine) energy. The turbine turns the generator rotor which then converts this mechanical energy into another energy form -- electricity.

A hydropower resource can be evaluated by its available power. Power is a function of the hydraulic head and rate of fluid flow. The head is the energy per unit weight (or unit mass) of water. The static head is proportional to the difference in height through which the water falls. Dynamic head is related to the velocity of moving water. Each unit of water can do an amount of work equal to its weight times the head.

The power available from falling water can be calculated from the flow rate and density of water, the height of fall, and the local acceleration due to gravity. In SI units, the power is:

$$P = \eta \rho Q g h$$

Where,
P is power in watts.

η is the dimensionless efficiency of the turbine.

ρ is the density of water in kilograms per cubic meter.

Q is the flow in cubic meters per second.

g is the acceleration due to gravity.

h is the height difference between inlet and outlet in meters.

Some hydropower systems such as water wheels can draw power from the flow of a body of water without necessarily changing its height. In this case, the available power is the kinetic energy of the flowing water. Overshot water wheels can efficiently capture both types of energy.

In this research I make use of height, gravity, tubes, etc. to generate clean energy at small scale. The efficiency is less but the effort required to generate it is less than available methods.

3. SELECTION OF COMPONENTS

Constraints to our aim:

- The electric current generated is DC of high voltage hence a voltage regulator is needed to bring it to 3.3V.
- Filter, Capacitor, etc. are needed to store Charge.
- Size should be compact.
- Easy to assemble and light weight.

TURBINE BLADES SELECTION:

There were three types of blades that I encountered to fulfill our task. The feature offered by each of them is mentioned to justify our choice.

- Francis turbine blade.
- Pelton wheel blade.
- Kaplan turbine blade.

FRANCIS TURBINE BLADE:

Francis Turbine is used when an impulse, as well as a reaction force, is provided by water.

PELTON WHEEL BLADE:

Pelton wheel is used when water is providing impulse force.

KAPLAN TURBINE BLADE:

Kaplan Turbine Blade is used when the reaction force is provided by water. Thus, I select Pelton wheel for this research.

GENERATOR

I have selected a DC generator with the following specification:

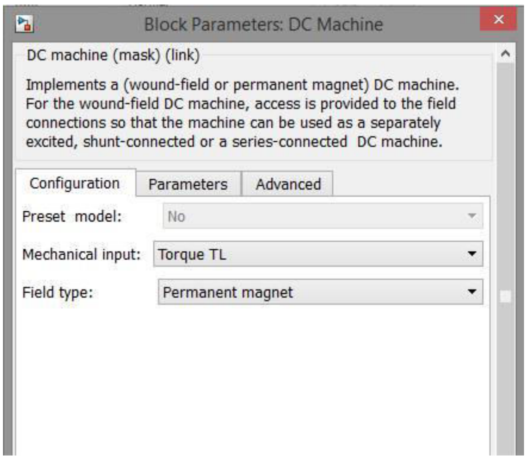

Figure 1. DC generator

OP-AMP:

A 3.2 V allowing op-amp was elected.
Voltage regulators:

A zener diode regulator was selected with following configurations:

Resistors:

4.7 k ohm & 1000 ohm were selected.

Rubber based material for the tank:
It is used for tank and reservoir in this project.

Flow control valves: A flow control valve regulates the flow or pressure of a fluid.

Bug strips & connecting pins:
It is used here for Connector in PCB. It makes connection easy in PCB.

AC to DC Converter:
It is used here for converting alternating current to direct current for charging circuit.

CIRCUIT FOR GENERATOR

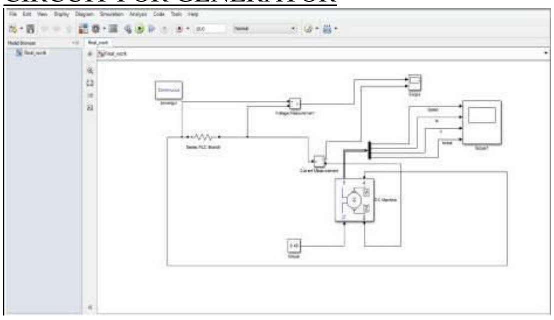

Figure 2. Simulation Circuit for Generator

The charging circuit will convert the input DC voltage of 3.45 V to 3.3V which will be accepted by the Radio Phone.

CIRCUIT FOR CHARGING CIRCUIT

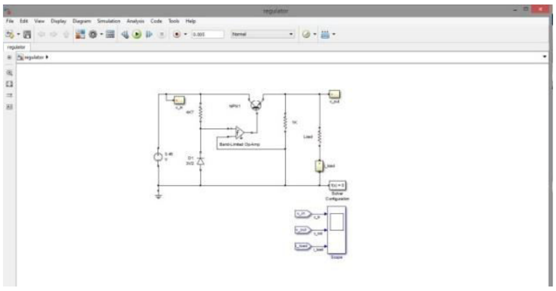

Figure 3. Circuit diagram of charging

4. SIMULATION RESULT FOR GENERATOR

Figure 4 Simulation Result for Generator

The simulation result shows that for an input torque of 3.48 units. The output generator shows are 3.45 V.

5. SIMULATION RESULT FOR REGULATOR

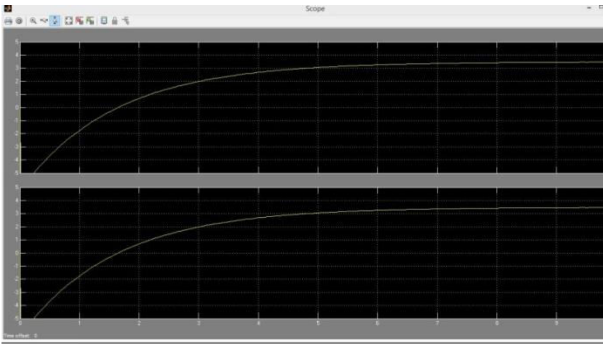

Figure 5. Simulation Result for Regulator

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Last but not the least, I would like to thank my parents and friends whose valuable support and advice helped us in times of need.

7. CONCLUSION

This article is basically focused on the development of a renewable energy based radio phone charger for military applications in Rain Forest areas. The flow diagram created in beginning was:

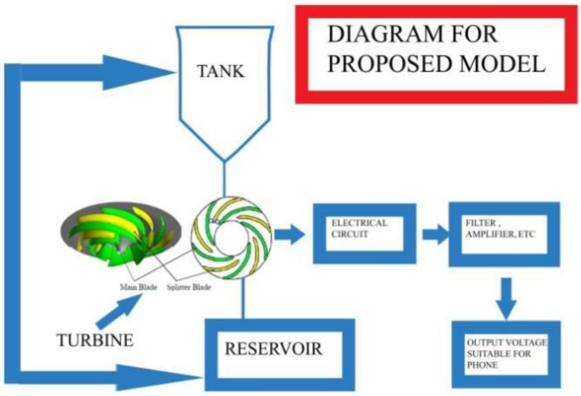

Figure 6. Flow diagram of model

Thus, output was achieved by adding additional electronics components. This new method is more reliable and effective means of harvesting rainwater energy. This article introduces a new power charging system which has a charging efficiency approximately by 90%, i.e. 4.988V DC rather than 5V DC.

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