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AN INNOVATIVE APPROACH FOR MANAGING RESIDENTIAL ENERGY DEMAND USING MINI HYDRO DYNAMO ELECTRIC GENERATOR

S.Shanmuga Priyan[1], T.Hariharan[2], Dr.S.Rajendran[3]

[1]Assistant Professor, [2]Sr. Assistant Professor, [3]Professor, Dhirajlal Gandhi College of Technology, Salem (India)

ABSTRACT

The aim of this project is to build such a system which gives electricity at low cost, which must be eco-friendly, easy to use and to store the generated power by means of battery charging for future use particularly during electricity blackouts. In the domestic pipeline the flow of water has enough kinetic energy to rotate the blade of a small hydro turbine which in turn rotates the rotor of a generator to generate electric power. Our project deals with development of mini hydro power plant at home through household water tanks. Water tank is connected with a cone shaped outlet such that the pressure of water is increased. The output of power generator is not sufficient to run basic loads during power cut, it is connected to a Boost converter and stepped up and stored in a Battery bank. Thus during power cuts and power discontinuities, it is proposed to use this power and run simple electrical loads like fans, tube light's etc. The same system may also be extended to use in municipality tanks for electrifying street lights. The novelty of the work includes even though generation of electricity using water pressure has already invented, that is used for only domestic power generation.But making electricity using water from household water tanks are simple and novel .This is more cheaper and easy to maintain.

Keywords: Mini Hydro System, Energy Storage, Renewable Energy And Small Turbine.

I. INTRODUCTION

India is blessed with immense amount of hydroelectric potential and ranks 5th in terms of exploitable hydro-potential on global scenario. Hydropower potential is estimated to the tune 1,48,700 MW out of which bulk potential is still to be harnessed. In the existing system the water we are consuming daily are not effectively utilized. Even though we are using it for household needs that cannot be considered as efficient usage. The drawback of the existing system is that water is not effectively utilized as it can be utilized for several other purposes too. In the proposed system water is used to generate electricity and also used for household purposes too. Hence no water is wasted. The hydro power which has a maximum electrical output of five kilowatts (2kw) is come under the category of Mini Hydro [4-5,9]. This system is beneficial than other large hydro system as it have low cost, can be installed at households, eco-friendly and easily available to people. This mini hydro technology have made it more economical power source in the developing country. AC can be produced which can be used to drive standard electrical appliances. Examples of devices which can be run by this system are light bulbs, radios, hybrid LED's.

In this system ,water is stored in water tank placed in households(This stored water is flows downhill through a pipe (penstock).The running water in the penstock has a enough kinetic energy to rotates the blade of a turbine which in turn rotates the rotor of a generator which produces electricity. However in this research paper it is shown that house hold water supply also have enough kinetic energy to rotate a small hydro turbine for energy production.

Hence this research is done to show that house hold water supply has additional capability for electrical energy production instead of other routine activities like bath, laundry, cook and cloth washing. Production of the electricity can be done without pay extra charges on the water bill.

The main function of this system is to store the generated power by means of battery charging for future use particularly during electricity blackouts. The proposed system produces 8.408W power which is very less as compare to other Pico micro hydro system but it is cost effective, easy to use, eco-friendly and easy to installed anywhere.

II. DEVELOPMENT OF THE PROPOSED MINI HYDRO SYSTEM

It consists of a turbine attached to an alternator. The Fig. 1 shows the block diagram of the proposed system.The water stored in the household water tank placed at certain meters height from the ground. When water is used for common household chores, the water flows from the tank downstream with some pressure.

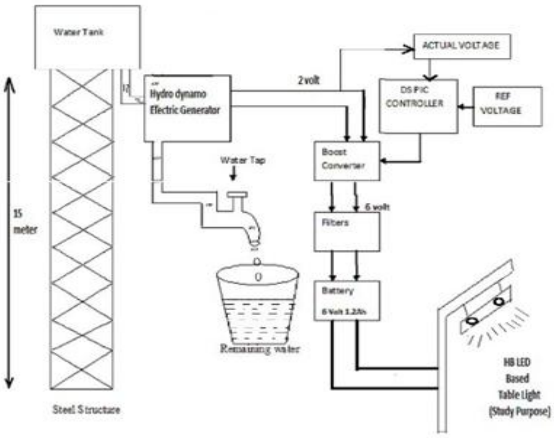

Fig.1: MiniHydroSystem

This water will face a turbine while travelling through the pipe. The turbine attached to the shaft of the mini hydro dynamo generator[1-3,5]. Because of the pressure of water the turbine rotates which in turn rotates the generator shaft and electricity is generated as a result. The generated electricity is not sufficient to run the loads as mentioned earlier.

So the power is stepped up to a necessary level to run the loads using a Boost Converter and stored in a Battery. The power can be used when needed and can be converted to AC through an Inverter when the load is AC.

2.1.Water Tank

The Water Tank is usually present at household's top which depends upon the Buildings. It is suggested that whenever the height of water tank is more than the pressure of water is more and speed of turbine is more and power generated is also more.

2.2. Hydro Dynamo Generator

A simple hydro electric generator model is shown in the Fig. 2.

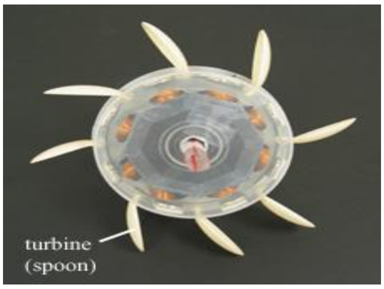

Fig. 2: Turbine attached Generator Model

In this type of generator the Turbine is directly attached to the shaft of the hydro dynamo generator. This is mainly done because to reduce the mechanical power losses in the system.

2.3. Boost Converter

Boost converter for the system is simulated using MATLAB /Simulink[11-10,15] platform and then physically designed. The simulated model of the Boost Converter for the system is shown in Fig. 3.

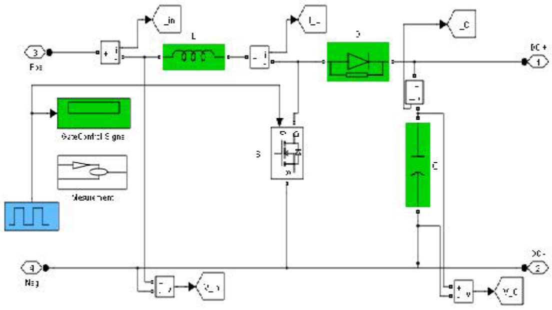

Fig. 3: Simulation Model of Boost Converter

In order to assess the performance of the proposed boost converter design, in models in MATLAB/SIMULINK have been developed.

As shown in Fig. 3 models of boost converter consists of inductor L, MOSFET switch S, Diode D and capacitor C. In addition to that, there are positive and negative DC input ports 3 and 4, respectively which received the signal from the DC generator, and positive and negative DC output ports 1 and 2, respectively which will be the input to the output load resistance or DC load. As shown in Fig.3,scopes are used to display the output results.

The input and output voltage of the proposed boost converter design is shown in Fig.4. As shown in the figure when the DC input voltage is 6.2 Volt, the output voltage of the proposed boost converter has stabilized to values approximately 24 Volt after 0.06 sec from the starting of the simulation.

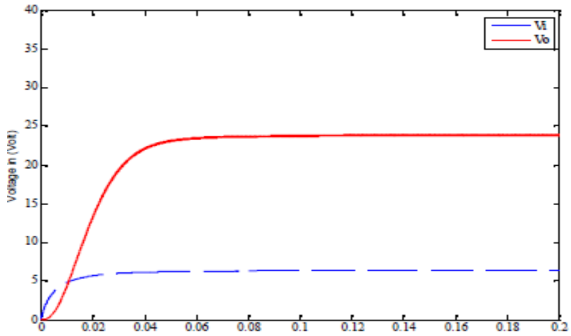

Fig. 4: The Input and Output Voltage of the DC-DC Boost Converter

2.4. Battery

Thus from the all the above analysis the input generated from the dynamo generator is very less to run the loads. The power generated from the generator is passed through Boost Converter and is stepped up to a necessary level and thus stored in a Battery. The Fig. 5 shows a simple 6v Battery.

Fig. 5: 6v Battery

III. SCHEMATIC VIEW OF ANIMATED MODEL OF THE SYSTEM

Fig.5 shows the animated model of the proposed system

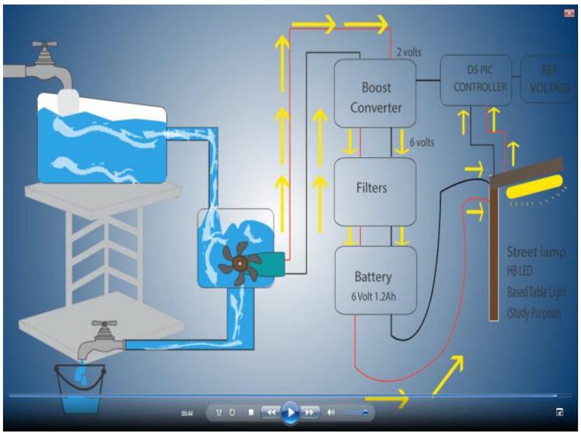

Fig.5: Animated Model of the System

IV. MATHEMATICAL ANALSIS

4.1Head Measurement

When determining head (fallingwater), grossor "static" head and netor "dynamic" head must beconsidered. Gross head is the vertical distance between the top of the pen stock and the point where the water hits the blades of the turbine. Net head is gross head minus the pressure or head losses due to friction and turbulence in the penstock. There are many methods of head measurement. How ever the proposed system uses domestic water supply and in this system Raman Hostel water supply is used which has1000L of waters to rage tank at a height of 21feet from the ground and the net head available to the turbine is 20 feet. Measurement of head is simply done by measuring height from the top of the floor where 1000L tank is installed and the point where the water hits the pelton turbine test-rig. 9ok .opoo Head losses depend on the type, diameter, and length of the penstock piping and the number of bends or elbows. Gross head can be used to estimate power availability and determine general feasibility, but net head is used to calculate the actual power available.

4.2 Water Flow Rate Measurement

The simplest flow of measurement for small streamsis the bucket method [4].Therefore, this method is used because the capacity of the proposed hydro power system is significantly small.

Moreover ,this method is consider ably more practical in the proposed system which is very uncommon compared too there system in its category. Through out this method, the flow rate of the distributed water is diverted into a bucket or barrel and the time it takes for the container to fill is recorded. Hevolume of the container is known and the flow rate is simply obtained by Power Estimation

In general, the feasibility of the proposed system is based on the following potential input/output power equation [2]:

$P_{in}=H\times Q\times g$(1)

$P_{out}=H\times Q\times g\times\eta$(2)

Where,

P_{in}=Input power(Hydropower)

P_{out}=Output power(Generatoroutput)H=Head(meter)

Q=Water flow rate(liter/second)

g=gravity(9.81m/s^2)

η=efficiency

In the proposed system Head=20feetor

6metersQ=0.285L/s

g=**9.81m/s^2**

Usingeq.1

$P_{in}=6\times0.285\times9.81$ = **16.817W**

Usingeq.2

$P_{out}=16.817\times50/100$(here$\eta$istaken as50%[1])

P_{out} =**8.408W**

Hence from the proposed system weget8.408 W corresponding to turbine power efficiency (50%).

4.3 Measurement of Speed, Current and Voltage

In this proposed system RPM is measured by digital tachometer by attaching a pin into the big pulley and readings are noted at different diameters of the tap (nozzle).

Since the ratio between pulleys is 10:1, so the small pulley of the system rotates 10 times more than big pulley.

Current and Voltage are measured by Digital Multi meter.

Form easuring the revalues the below cases has been taken.

Case : Reading at 20 Feet Head

At20 feet current, voltage and rpmis measured at different values of diameter of tap (nozzle)as showninTable1.

Table1:Values of RPM, Voltage and Currentat 20 feet for differentdia. Of Tapat 20 Feet

Diameter(tap) (mm)	RPM (smallpulley	Voltage(V)	Current(mA)
5	150×10	5.646	6.87
6	140×10	5.04	6.14
8	133×10	3.98	4.85
12	122×10	2.89	3.52

Graph between different parameters (current, voltage, diameter and RPM×10) at 20 feet as shown belowin Fig. 6.

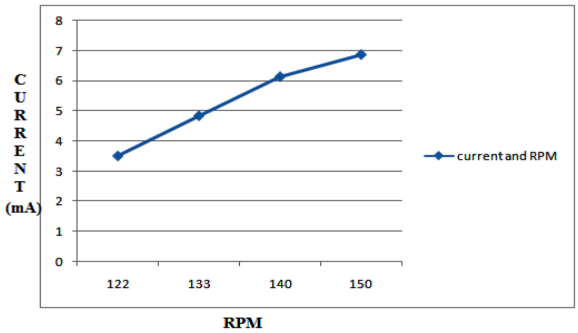

Fig.6(a):Graph b/w Current and RPM

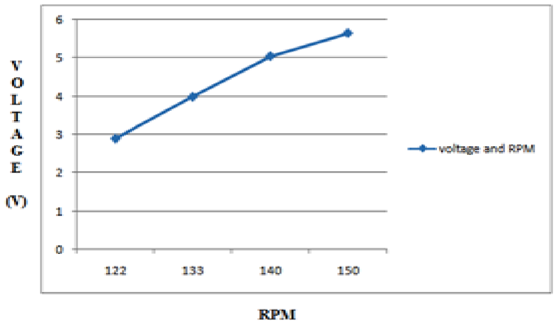

Fig.6(b):Graph b/w Voltage and RPM

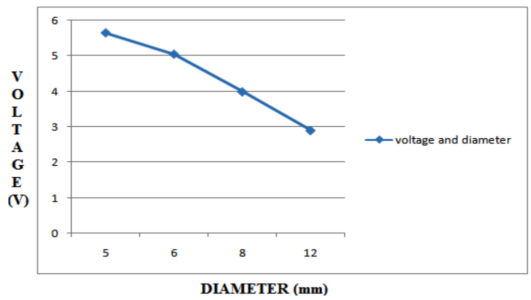

Fig. 6(c): Graph b/w Voltage and Diameter (tap)

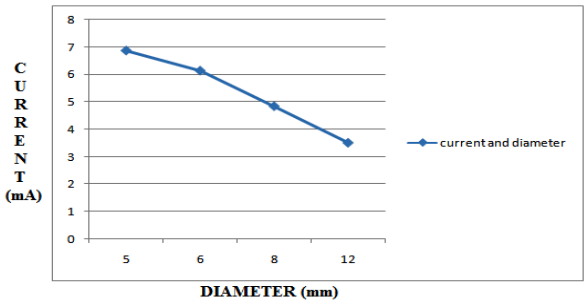

Fig.6(d): Graph b/w Current and Diameter (tap)

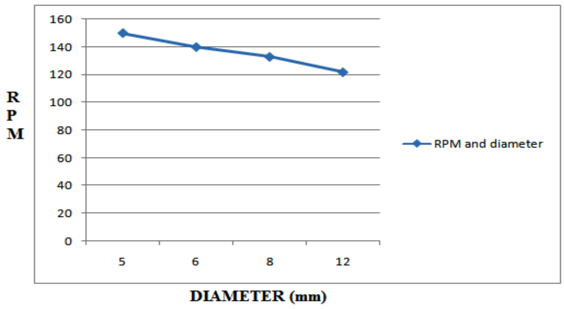

Fig. 6(e): Graph b/w RPM and Diameter (tap)

Fig.6: Graph between Different Parameters (Current, Voltage, and Diameter and RPM × 10) at 20 Feet

From Fig.6 and Table1, the following results are obtained.

3.3.1 From graph 6(a) and6 (d)we depicted t hat Current in creases when RPM increases and decreases when diameter of the tap increases.

3.3.2 From graph 6(b) and6 (c) we depicted that Voltage increases when RPM increases and decreases when diameter of the tap increases.

3.3.3 From graph6 (e) RPM increases when diameter of tap decrease

V. CONCLUSION

This system is simple, safe and cost effective which provides basic needs to the developing countries. By using this system one can charge batteries through which many electric applications can be run. This system can not only be a solution for India, where this study was performed, but could be an option for many regions worldwide.

In this research paper it is found that the current, voltage and RPM are inversely proportion to the dia. of tap and directly proportional to the head.

Hence it is concluded that there are two main input parameters which are very important in ensuring the developed mini hydro system to function as an alternative electrical power generator for residential use. The parameters are the pressure of the main pipeline water supply that representing the head (falling water) and the water supply flow rate. These parameters vary between residential areas. Hence, it is essential to determine both parameters at early stage for potential output power estimation.

The maximum value current, voltage and RPM are 6.87 mA, 5.646 V and 1500. This system efficiently capable of charging a 6 V battery which is used for various purposes, in this system it is used to light up a 5 W CFL.

In addition, since the turbine and generator are manufacture locally, so the selection of turbine and generator in terms of their type and size or capacity is also. The power developed in the proposed system is 8.408 W. important in designing and developing the proposed mini hydro system. Wrong type and improper sizing of these components would cause the system to operate at undesirable performance.

IV. ACKNOWLEDGEMENT

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Professor/ EEE/ KSRCT.

REFERENCES

[1]. "Analysis of Inductor-Current of Boost DC-DC Converters and its Design for Intrinsic Safety"-Tong Jun, School of Electrical and Control Engineering Xi'an University of Science & Technology Xi'an, China.

[2]. "Automatic Voltage Regulation of High-Efficiency Interior Permanent-Magnet Synchronous Generators for Pico-Hydro Power Generation System"-K. Kurihara,K. Saito, and T. Kubota Department of Electrical and Electronic Engineering.

[3]. "Improved Power Conditioning System of Micro-Hydro Power Plant for Distributed Generation Applications"-Marcelo G. Molina1, Mario Pacas2 1CONICET, Instituto de Energía Eléctrica Universidad Nacional de San Juan, San Juan, Argentina Institute of Power Electronics and Electrical Drives.

[4]. "Pico-Hydro Power Generation using Dual Pelton Turbines and Single Generator"-Ahmad Khusairee Yahya, Wan Noraishah Wan Abdul Munim.

[5]. "Design and Development of Hybrid Wind-Hydro Power Generation System"-Krishan Kumar Dept. of Electrical Engineering Gautam Buddha University Gr. Noida, India Email: tyagi315@gmail.com,M. A. Ansari, Senior Member.

[6]. "Reassessment of Irrigation Potential for Micro Hydro Power Generation"-Mrs.S.P.Adhau, Dr.R.M.Moharil, Mr.P.G.Adhau Y.C.C.E. Nagpur University, India1, Y.C.C.E. Nagpur University.

[7]. "An Active Soft Switched Phase-Shifted Full-Bridge DC–DC Converter: Analysis, Modeling, Design, and Implementation"-Gorla Naga Brahmendra Yadav.

[8]. "An Isolated Multiport DC–DC Converter for Simultaneous Power Management of Multiple Different Renewable Energy Source"-Jianwu Zeng, Student Member, IEEE, Wei Qiao, Senior Member.

[9]. " Design and Development of Pico Micro Hydro System by using House hold Water Supply" Gunjan Yadav1, A.K Chauhan21M.Tech, Department of Mechanical Engineering, KNIT, Sultanpur, UP, India 2Assistant Professor, Department of Mechanical Engineering, KNIT, Sultanpur, UP, India

[10]. "An Active Soft Switched Phase-Shifted Full-Bridge DC–DC Converter: Analysis, Modeling, Design, and Implementation" Gorla Naga Brahmendra Yadav and N. Lakshmi Narasamma

[11]. "Buck/Boost DC–DC Converter Topology with Soft Switching in the Whole Operating Region"- Martin Pavlovsk´y, Member, IEEE, Giuseppe Guidi, Member, IEEE, and Atsuo Kawamura, Fellow, IEEE

[12]. "Sub harmonic Stability Limits for the Buck Converter with Ripple-Based Constant On-Time Control and Feedback Filter" - Chung-Chieh Fang and Richard Redl, Fellow, IEEE

[13]. "Isolated Coupled-Inductor-Integrated DC–DC Converter with Non-dissipative Snubber for Solar Energy Applications"jian-hsieng lee, tsorng-juu liang, senior member, IEEE, and jiann-fuh chen, member, IEEE

[14]. "Self Excited Induction Generator and Municipal Waste Water based Micro Hydro Power Generation System" r. k. saket and lokesh varshney

[15]. "Distributed Mini Power Plants for Lebanon: a Simulation Design using MATLAB/SIMULINK" Prof. Maged B. Najjar, IEEE member Electrical Engineering Department University of Balamand North Tripoli, E. Ghoulam, H. Fares, Students Electrical Engineering Department University of Balamand.