Design and Performnce Study of Domestic Hydro Power Plant

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Abstract: Hydropower generated systems are one of the common source to generate energy. The renewable energy generation system is designed to use the water flow from an overhead tank during normal consumption of water for domestic use. The system produces electricity from the potential energy of water flow through water pipelines by changing the kinetic energy of water into electricity. The electrical energy is stored in batteries for domestic purposes like lighting and other electrical applications. The system has two turbines coupled with generator, placed at the inlet and outlet pipe of the water tank. The status of water level is detected with the help of float sensor. The motor performs automatically according to the level of water. The generated power is informed to the user and then stored in a battery storage unit. When the energy saved within the battery is sufficient an inverter is switched ON for domestic use. During the normal time of working load receives power from the ordinary commercial line. The system is simulated with Proteus software and analysed.

KEYWORDS: renewable energy generation, turbine generators, proteus simulation

DOI of the Article: https://doi.org/10.46501/IJMTST0706045

Available online at: http://www.ijmtst.com/vol7issue06.html

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To Cite this Article: Birundha R and Dr Maruthapandi P. Design and Performnce Study of Domestic Hydro Power Plant. *International Journal for Modern Trends in Science and Technology* 2021, *7*, 0706160, pp. 266-271. https://doi.org/10.46501/IJMTST0706045

Article Info. Received: 15 May 2021; Accepted: 14 June 2021; Published: 20 June 2021

INTRODUCTION

In most of the modern houses people use water available from a water tank placed on the roof of a house. Water is pumped and stored in the tank. The accumulated water gains a potential energy level depending on the height of the tank. When the water flows axially through the water pipeline, it generates kinetic energy. The small turbine coupled with a DC generator converts the kinetic energy to electricity.The generated electricity is accumulated in the power storage unit. When the level of power accumulated in a battery is quite significant, the commercial power supply used for household applications switches to power stored in the battery storage unit.

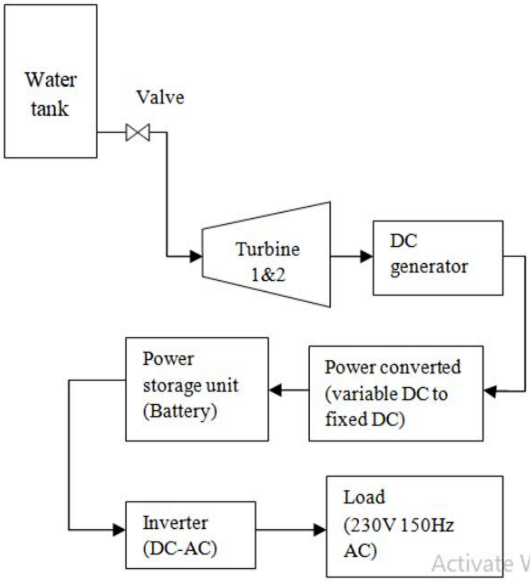

Figure1 In house- Hydro power generation

The power consumption continues till the battery is exhausted. Then switch back to the commercial power line. Throughout the year substantial energy is generated which otherwise was a waste. Electricity generation done locally in a decentralized manner for more efficient way of power management .Overhead water tanks are a common method of supplying water and normally installed in all houses. The proposed scheme found a common application that generates green and renewable energy and saves a lot of commercial energy consumption.

The water flows downward due to gravity whenever water is consumed from an overhead tank in a house. A small DC generator coupled with the turbine, generates electricity with flow of water as shown in the Figure 1. The renewable hydro-electric power is generated using a small turbine, the generated power is converted from variable DC to fixed DC power as shown in figure, In-house hydro power generation. The converted power is stored in a power storage unit; the generated DC is converted to AC power and sent to the load.

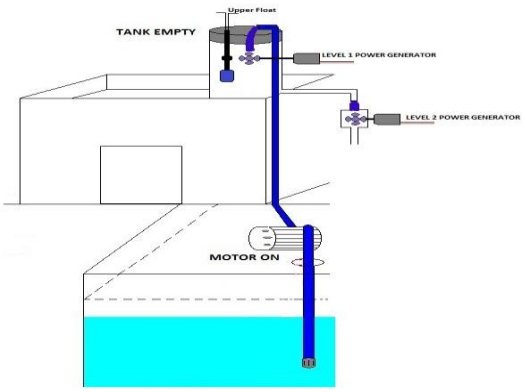

Figure 2 Model Setup

RELATED WORK

Small hydropower plants (SHPs) have a large development potential because of the increasing interest in renewable resources and distributed energy generation [1]. The variable hydrological conditions that are found in run-of-the-river require operations over a wide range of water flow and head variation. SHP solution based on an innovative generation unit (hydro-set). A propeller turbine is integrated with a permanent magnet synchronous generator working at a variable speed in a grid connected system. An actual 150-Kw SHP that contains two innovative hydro sets working in parallel on the same river as discussed in paper "Small Hydropower plant with integrated Turbine-Generators working at variable speed" [1].

Water is the first renewable source used to generate electricity. After converting water's power to electricity in hydro power stations water falls down back to the river. Water leaving water turbines is called Tailwater. Tailwater still has energy to be converted. To produce electric energy from the tail water of the plant has been investigated. The study of Sanibel water dam's tail water data has been used to determine optimum size and number of hydromatrix turbines to be installed to maximize electrical energy production. "Hydropower Plants tailwater energy production and optimization" [2].

The water level measurement data is very important in some water-related fields[3]. An automatic water level measurement system is needed to prevent the difficulties when one does the measurement manually. AT89S51 microcontrollers are used to control the system and ultrasonic sensor to measure the water level,

SIM300C GSM modem to receive and send SMS. Some automatic water level measurement systems have been made using mechanical sensors such as resistive, capacitive or magnetic sensors, but these sensors have to do direct contact with water that makes their life span shorter because of corrosion. Besides that, resistive and magnetic sensors can only measure the water level at some points. "Design and construction of a water level measurement system accessible Small hydropower plants (SHPs) have a large development potential because of the increasing interest in renewable resources and distributed energy generation [1]. The variable hydrological conditions that are found in run-of-the-river require operations over a wide range of water flow and head variation. SHP solution based on an innovative generation unit (hydro-set). A propeller turbine is integrated with a permanent magnet synchronous generator working at a variable speed in a grid connected system. An actual 150-Kw SHP that contains two innovative hydro sets working in parallel on the same river as discussed in paper "Small Hydropower plant with integrated Turbine-Generators working at variable speed" [1].

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HYDROPOWER PLANT

Hydro power is electrical energy produced through the power of moving water.In modern technology, hydropower moves turbines that pass on their energy to a generator which then produces electric power. Hydropower is a type of renewable energy, and once the power plant is constructed it produces little to no waste.

Hydropower plant captures the energy of falling water to generate electricity. A turbine converts the kinetic energy of falling water into mechanically strong energy. Then a generator converts the mechanical energy into electrical energy. Most conventional hydroelectric plants include four major components like dam, turbine, generator and transmission lines.

Hydropower from many kinds of watermills is used as a renewable energy source for irrigation and the operation of various mechanical devices, such as grist mills, saw mills, textile mills, trip hammers, dock cranes, domestic lifts etc..,

SYSTEM DESCRIPTION OF THE PROPOSED SYSTEM

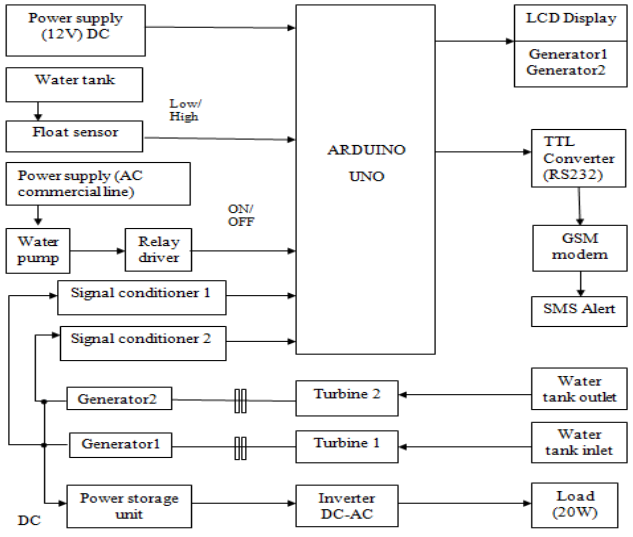

Figure 3 Block diagram of the Proposed System

The small turbine coupled with a DC generator converts the kinetic energy to electricity. The proposed system consists of two turbines, one connected to the inlet of the water tank and other connected at the outlet of the water tank. The level of water content in the tank is measured using the ball-headed float sensor. After measuring the level of water content, the message will

be sent to the user as an SMS. If the level of water in the tank is low, the motor gets ON automatically. If the level of water in the tank is high, the motor gets OFF automatically. The power generated by each turbine is displayed in the LCD board. The displayed power is also sent to the user as a message to the registered telephone number for easy communication of customers.

The GSM modem is provided with a SIM800c sim card. This helps in transferring the collected data from motor, float sensor, generator and inform users with sending an SMS to a registered number. The generated power is stored in the battery storage unit as shown in Figure 3 and used when required.

FLOW CHART

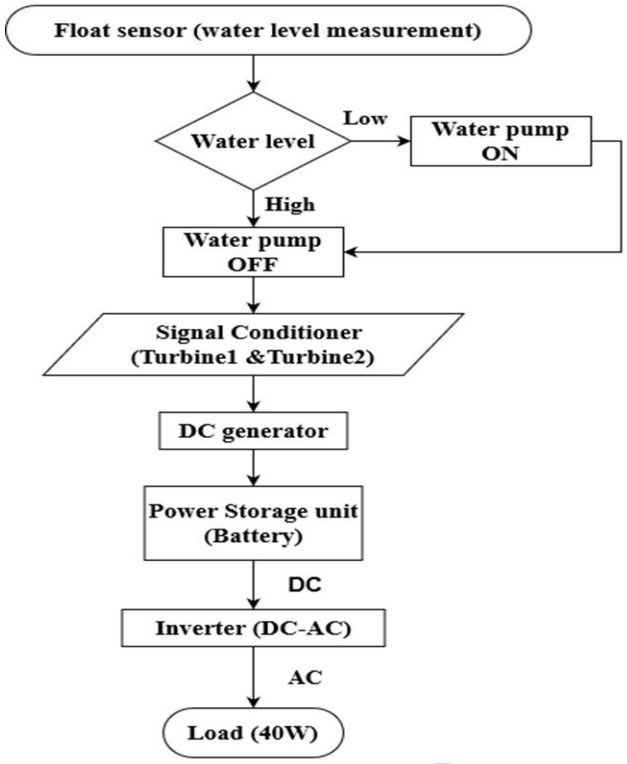

Figure 4 Flowchart of the proposed system

The water tank is kept at a maximum height in buildings like multi-storied apartments. The working of a motor depends on the level of water dumped in the tank. A ball-headed float sensor is fixed inside the water tank. The float sensor helps in measuring the water level. If the level of water is low the user is informed with a message and the motor gets ON. If the level of water is high the float sensor informs the user with an SMS and motor OFF. There are two turbines fixed at the inlet and outlet pipe of the water tank. When the water flows through a pipeline, the turbines coupled with generators convert kinetic energy into electrical energy. The amount of power generated is sent to the signal conditioner and is interfaced with the Arduino module. The generated power is stored in the battery storage unit. The wattage generated is sent to the user for easy communication. This system helps in improving the communication with users. The working condition of the motor, measurement of water level in the tank and amount of power generated is recorded to the user with an SMS to registered telephone number.

The stored power in the battery storage unit is DC supply. The DC power is converted to AC power as shown in Fig. 2.3 using an inverter. The converted power is sent to load. The battery storage unit performs like an uninterrupted power supply unit. The stored power can be used when there is power shutdown. The wasted energy is now transformed to an efficient power by reducing manpower and saving the user's time.

CIRCUIT SIMULATION

When the user presses the button switch a signal is sent to the Arduino module that decides the working condition of the motor. Then the command generated by the float switch and motor is displayed on a small tab for communication purposes of the user. That turbine generator switch has an increment and decrement terminal to choose the amount of power. Depending on the accessed turbine generators terminal the power is displayed on the LCD Display. The power generation of both generated are specifically displayed on the screen.

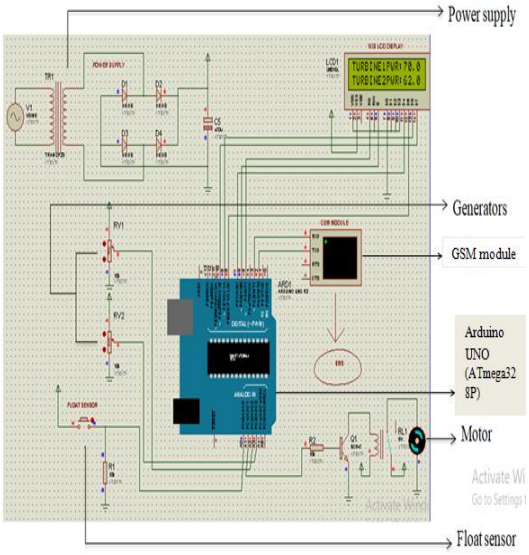

Figure 5 Simulation circuit of the proposed system.

The GSM module is connected with the software serial port in the simulation circuit. The software serial port is issued to configure the receiver and transmitter pins of the Arduino module to the pins 2 and 3 as shown in the simulation circuit.

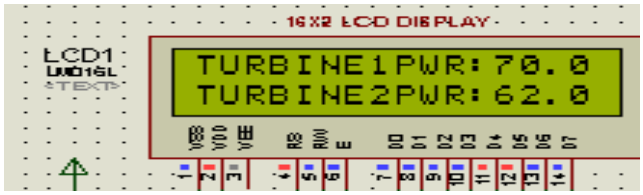

Figure 6 The LCD display the generated power by the turbine generators

The configuration is done to reduce the dumping of program synchronization in the controller port. The liquid crystal display library decides the connection of pins Rx, enable, D4, D5, D6 and D7 in the Arduino microcontroller as shown in These pins are used to interface the Arduino with LCD to display the generated power by the turbine generators.

The Interface module easily connects to the user via communication. The applications like SMS control data transfer and remote control are done using GSM modem as shown in Figure 7.

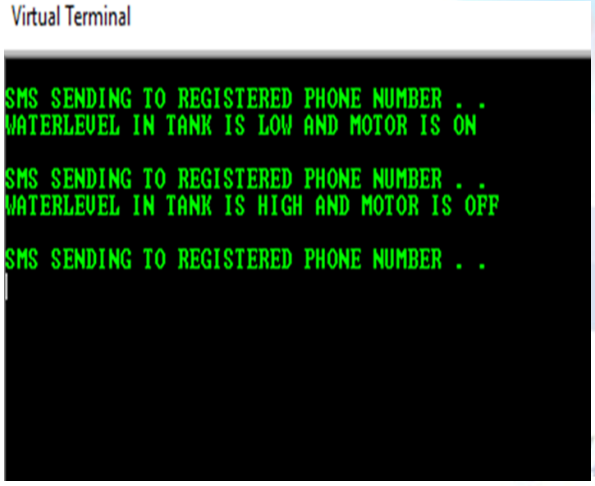

Figure 7 Virtual Terminal for User via Communication

The messages informed to the user are displayed on the virtual terminal as shown in Fig.7. and then sent SMS successfully to the registered telephone number.

OUTPUT AND RESULTS

The power is generated using generators coupled with turbines. The generator is connected with an Arduino module using a signal conditioner for each. The signal conditioner converts generated voltage to pulse signal and sends it to the Arduino module.

The generated power is displayed in the LCD displayed for each power generation output 1 to output 6. The power generated in each turbine is informed to the user with an SMS. The frequency of motors for different intervals is tested and power generated by the turbine generators is observed and tabulated is shown in table 1.

S/No.	Frequency of motor ON / day	Time required to fill tank (mins)	Power generated by Turbine 1 (Watts)	Power generated by Turbine 2 (Watts)
1.	1	45	62.0	51.0
2.	2	45	68.0	57.0
3.	3	45	71.0	62.0

Table 1 Tabulation of the simulation circuit

The generation of power for various intervals is tabulated as shown in Table 1 at 45 minutes each.

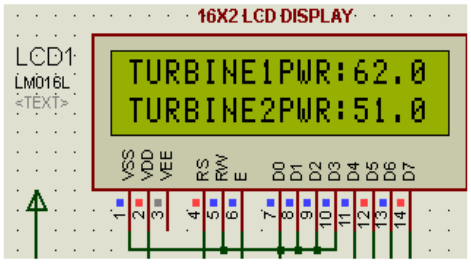

Figure 8 power generation output 1

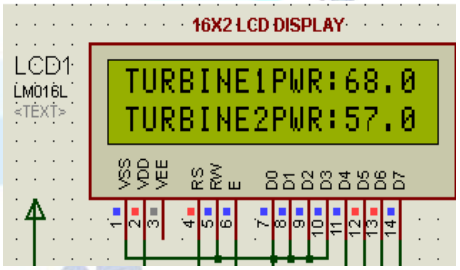

Figure 9 power generation output 2

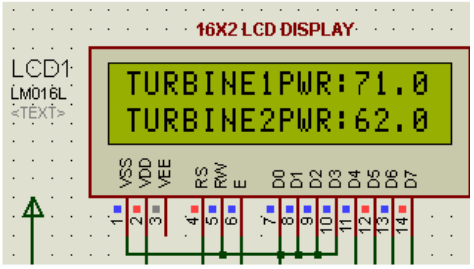

Figure 10 power generation output 3

The generated power output for different intervals of time is displayed as shown in Figure.3.9 (a-c). The power generated for each turbine at particular intervals is displayed and calculated.

RESULTS AND DISCUSSION

The generators successfully generate power and are stored in a power storage unit. The observation is done by performing the procedure of the proposed system at various time intervals .The Rigorous testing with three intervals for getting optimum results. The time duration taken by the motor to fill the tank is about 45 minutes.

The power generated for the first three intervals is shown in Figure 11 as a bar graph. The generated power at each interval is clearly identified from the graph.

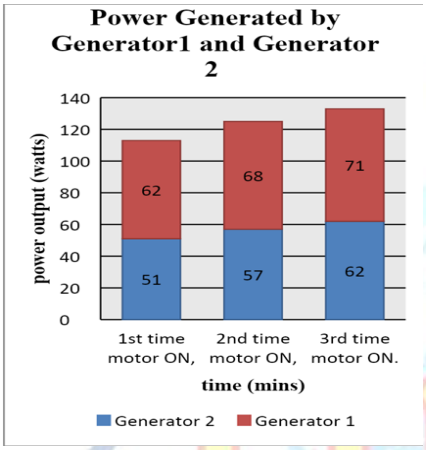

Figure 11. Graph of simulation circuit

CONCLUSION AND FUTURE SCOPE

The power is generated from turbines coupled with generators each at the inlet and outlet of the water tank. The level of water in the sump is measured using a float sensor, according to the water level the motor starts to work. The motor performs based on the information of water level sensed. When the water level is low, the motor starts to perform automatically and vice versa. Basic experiments have been performed. Rigorous testing with long term observation will be required for getting optimum result. The user is acknowledged with a message at each time the motor runs. The booting modem and the SMS sent to the user is displayed on LCD. The generated power at both inlet and outlet of the water tank is stored in a battery storage unit. When the energy stored within the battery is sufficient, the inverter gets switched ON to convert the energy to necessary AC power for the domestic use.

The future scope of the system deals with the new technological performance of the system. The segregation of saltwater and freshwater in the water tank using sensors can be done. Increase the amount of power generation with more efficient turbines. The amount of power generated through renewable energy systems can give a strong support for domestic purposes and no energy will be wasted.

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