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Implementation of Renewable Energy System Using Domestic Hydro Power Plant

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Abstract: Hydropower generated systems are one of the common sources to generate renewable energy. The improvement of a hydroelectric generating system that produce electricity from the potential energy of water flowing interior building's water pipelines through changing the kinetic energy of water into electricity. This electrical energy can be stored in batteries for use as power supply for domestic purposes like LED lighting, for charging mobile phones etc., The renewable energy generation has been designed to use the water flow from an overhead tank during normal consumption of water for domestic use. Kinetic energy of the falling water is used to rotate a turbine coupled with a DC generator. The generated DC power is stored in a battery unit. When the energy saved within the battery is sufficient an inverter is switched ON to generate AC power for domestic use. During the normal time of working load receives power from the ordinary commercial line. Potential energy of the water stored inside the overhead tank is then utilized to complement some electricity used in the form of hydro-energy. The process of generating power is quite substantial.

Keywords: Hydropower generation, DC Generator, Hydro-electricity, overhead tank.

I. INTRODUCTION

Normally 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 power storage unit. When level of power accumulated in battery is quite significant, the commercial power supply used for household applications switch to power stored in battery storage unit. The power consumption continues till the battery is exhausted. Then switch back to commercial power line. Throughout the year substantial energy can be generated which was otherwise was a waste. Electricity generation done locally in a decentralized manner for more efficient way of power management. Overhead water tank is a common method of supplying water and normally installed in all houses. The proposed scheme will find a common application that will generate green and renewable energy and save 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 the flow of water as shown in the Fig 1.

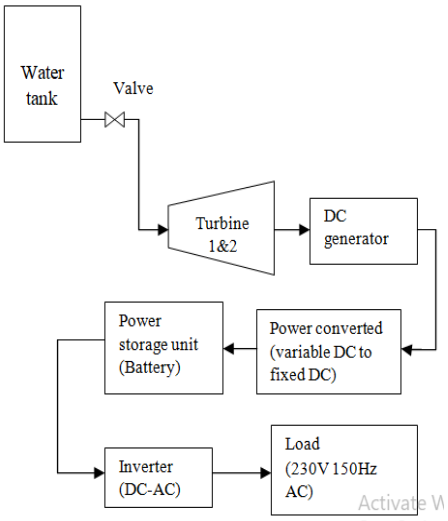

Fig1: In-house hydro power generation

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The renewable hydro-electric power is generated using a small turbine, the generated power is converted from variable DC to fixed DC as shown in figure, In-house hydro power generation. The converted power is stored in power storage unit; the generated DC is converted to AC and send to the load.

II. THE PROPOSED SYSTEM

There are many small domestic hydro power plants generating electric power. The proposed system has two turbines connected to the inlet of the water tank and other near the outlet of the tank. The level of the water content in the tank is measured by the float sensor. After measuring the level of the water, the message will be send to the user as a SMS.

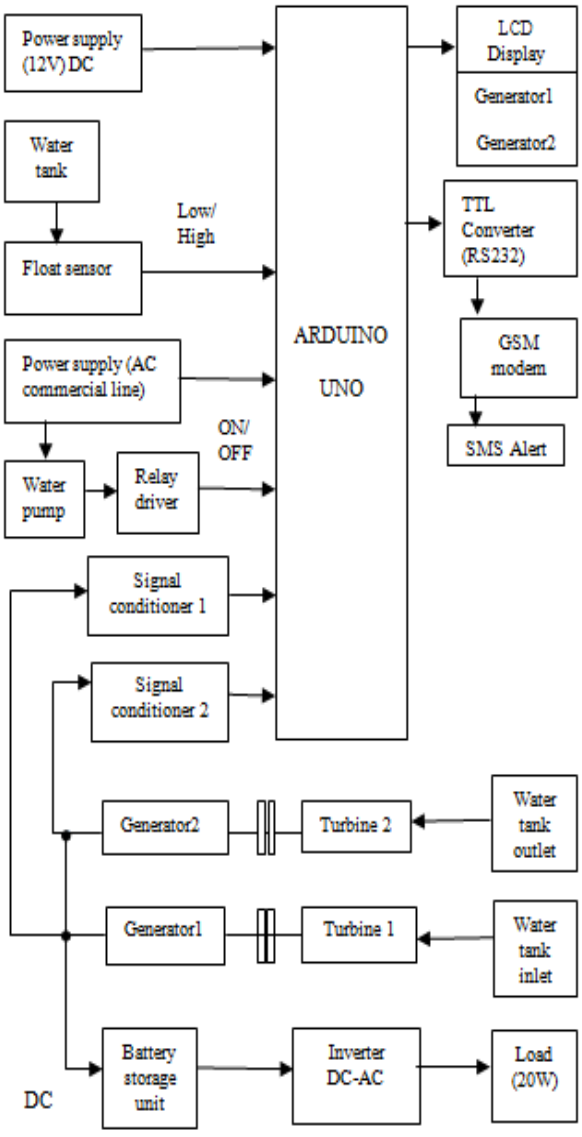

Fig 2: Block diagram of the proposed system

Then, the motor gets ON automatically when the level of water is less and the motor gets OFF when the level of water in the tank is full. The power generated by the two turbines will be calculated and displayed on the LCD display. The generated power will be stored in the battery storage unit as shown Fig 2 and used when required. The wasted energy is saved and can be used in a productive manner.

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A. DC GENERATOR

A DC generator is used to convert mechanical energy to DC electricity, capacity of generator is up to 300W. The DC generator is coupled with a turbine1 and turbine2. The energy conversion process use the principle of energetically induced electromotive force. The Arduino module receive signals from Signal conditioners. The signal conditioners get the input from generator 1 and generator 2.

B. FLOAT SENSOR

A float switch is a type of level sensor used to detect the level of water in tank. The float sensor and motor is interfaced with the Arduino module ATmega328P. The float sensor measure the level of water and control the water pump with the information provided by the sensor. This is an electromagnetic ON/OFF switch, it helps to sense the water present in both overhead and bottom of tank, act as a magnetic float sensor. The measured level of water is alerted to user with an SMS and motor runs automatically.

C. SIMCOM GSM / VOICE MODEM

The GSM modem (SIM800CS) work with a GSM Network operated simcard like a mobile phone with a unique telephone number as shown in Fig 3. The information given by float sensor to measure the water level, motor to ON/OFF, power generated by generator 1 & 2 are given to the user.

Fig 3: GSM modem (SIM800CS)

The modem is connected to Arduino module directly to interface the float sensor, motor, generator. The applications like SMS control data transfer and remote control is done using GSM. This helps in communicating with the user easily.

D. LCD DISPLAY

An LCD is an electronic display module which uses liquid crystal to produce a visible image. The display does not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. The use of LCD varies as the use of the customers for different purpose. LCDs are made with either a passive matrix or an active matrix display grid. The 16*2 LCD display is a very basic module commonly used in DIYs and circuits. The 16*2 translates a display 16 characters per line in 2 such lines as shown in Fig 4. The LCD display used in the proposed system is 16*2 displays. The LCD display is used to view the power generated by the turbine1 and turbine 2 as shown in the Fig 5.

Fig. 4: LCD display (16*2 display)

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Fig 5: Power generated by turbine1 & turbine 2

E. INTERFACE MODULE

The TTL converter is an interface module, connects both arduino and GSM module with two way communications. The converter RS 232 cable provides a two way serial communication between its outputs. The serial conversion takes place between the arduino module and the GSM module and alerts the user with an SMS. The modules are connected to a personal computer RS232 serial COM port. The converter is used in any microcontroller which has TTL two way serial communications.

F. FLOW CHART

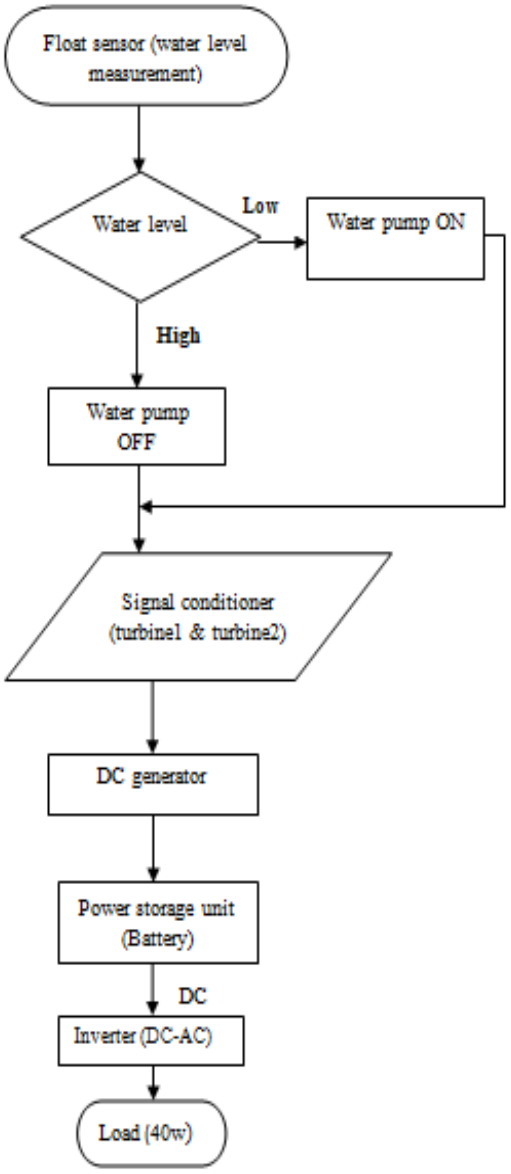

Fig 7: flowchart of proposed system

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F. RELAY DRIVER

The Relay (SRD-05VDC-SL-C) driver is used to control the motor connected to water tank l. The Arduino operates at 5V but it cannot control higher voltage devices directly. So, the 5V relay is used to switch the current and the relay is controlled by Arduino UNO ATmega328P. There are 5 pins in a relay, two pins A and B are at the two ends of a coil that is kept inside the relay.

Fig 6: Relay driver (SRD-05V DC-SL-C)

H. TURBINE

The Kaplan turbine is a propeller type water mechanical rotary engine. The turbine is fixed in the water pipeline and coupled with a DC generator. The small turbine has a capacity upto 1KW. Water flows in an inward direction in the water pipe. The axial flow of water changes the fluid pressure as it moves through the turbine and gives energy. The generated energy is converted into electricity with a help of DC generator.

I. ARDUINO UNO

The Arduino UNO (ATmega328P) is a microcontroller board used to communicate with other modules. It has 14 digital/ output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button as shown in Fig 8. The Arduino module is interfaced with float sensor, relay driver, signal conditioner1, signal conditioner2, LCD display, TTL converter RS232), power supply to the water tank and water pump.

Fig 8: Arduino UNO

The Arduino microcontroller is used in the system to perform number of functions interfaced. The operating voltage of Arduino module is 5V and the input voltage 7-12V this module cannot perform for higher voltage devices so relay switch attached with the module.

III. HARDWARE MODULE

The power supply is send to the microcontroller module. The Arduino microcontroller module is interfaced with relay driver, LCD display, float sensor, two signal conditioner and TTL converter as shown in the Fig 11. Relay driver is used as a switching device, which helps to control the motor automatically after the message is received by the user.

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The float sensor is used for measuring the water level. After measuring the level of water, SMS will be sending to the user as shown in the Fig 9, 10. The microcontroller interfaced with GSM modem helps in sending the message.

Fig 9: Motor ON, The SMS is sent successfully to registered phone number.

Fig 10: Motor OFF, The SMS is sent successfully to registered phone number.

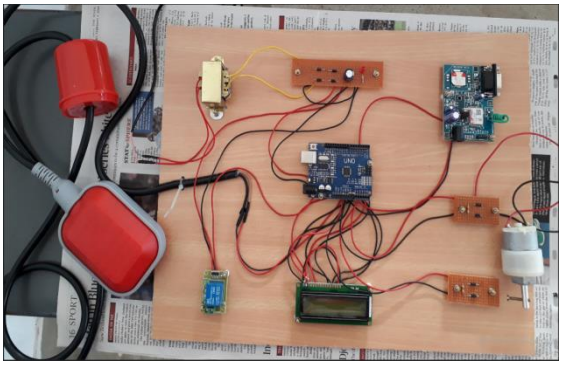

Fig 11: Hardware module of proposed system

The TTL converter cables provide two way serial communications between the Arduino board and GSM modem. There are two signal conditioner interfaced with respective turbines that converts one type of electronic signal into another type of signal. The LCD display used in this system is 16*2 display, it view the power produced by the turbine 1 and turbine 2. Each time when the water pumps to tank the power is generated by the turbines through the process. All the produced wattage is stored in the battery storage unit. The stored power is used whenever necessary for the domestic purposes.

IV. SOFTWARE

The Generator1, Generator2, LCD display, GSM module, water pump and float sensor is interfaced with the microcontroller ATmega32sp. The motor rotates as the supply is given from the AC commercial line. A float sensor is connected to the A0 of the controller. The water level is measured by the float sensor and sends information to the Arduino module. The sensor represents level of water in form of voltage (0V- low level, 5V-high level) in the simulation.

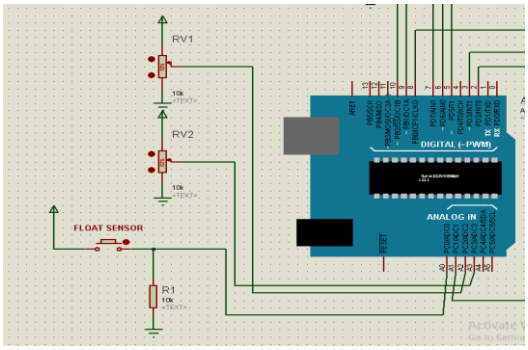

Fig 12: Simulation circuit for Float sensor

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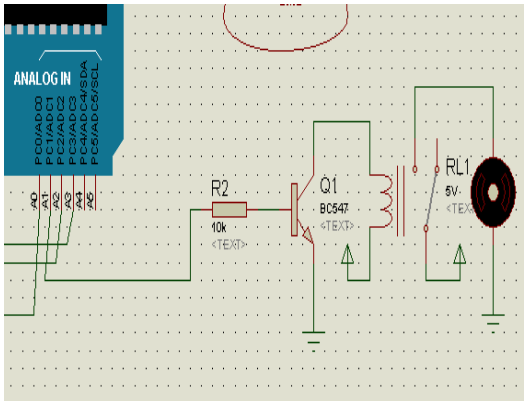

Fig 13: Simulation circuit for Motor module

The GSM module is connected with the software serial port in the simulation. We use the software serial port to configure the receiver and transmitter pins of the module to the pins 2 and 3. 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 figures8, 9, 10 of simulation circuit. These pins are used to interface the arduino with LCD to display the generated power by the generator1 and generator2.

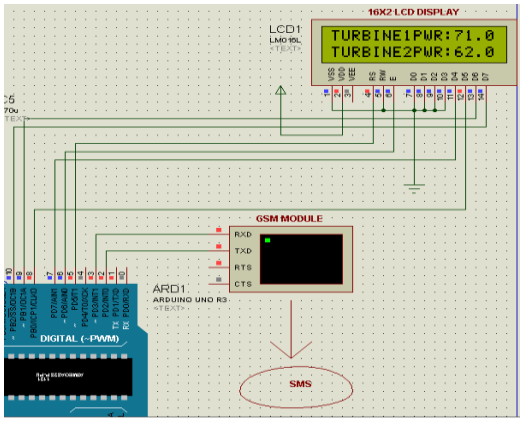

Fig 14: Simulation circuit for GSM module

V. RESULT AND DISCUSSION

The generators successfully generated power and stored in power storage unit. The observation is done by performing the procedure of proposed system at various time intervals. The Rigorous testing with three interval for getting optimum result. The time duration taken by the motor to fill the tank is about 45 minutes. The power is displayed for three intervals as shown in Fig 15, 16, 17 and observed result is tabulated as shown in bar chart Fig 18. This system is cost effective and highly reliable to use.

Frequency of motor ON / day	Time required to fill tank (mins)	Power generated by Turbine 1 (Watts)	Power generated by Turbine 2 (Watts)
1	45	62.0	51.0
2	45	68.0	57.0
3	45	71.0	62.0

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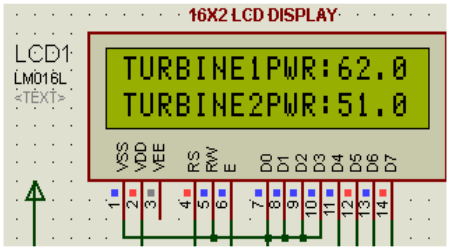

Fig 15: Power generation output 1.

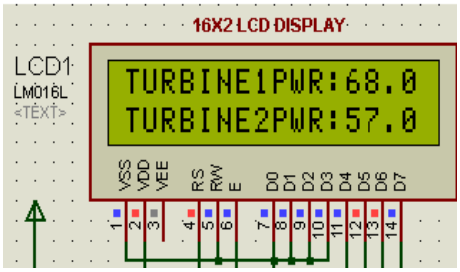

Fig 16: Power generation output 2.

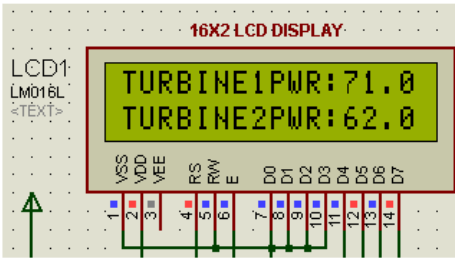

Fig 17: Power generation output 3.

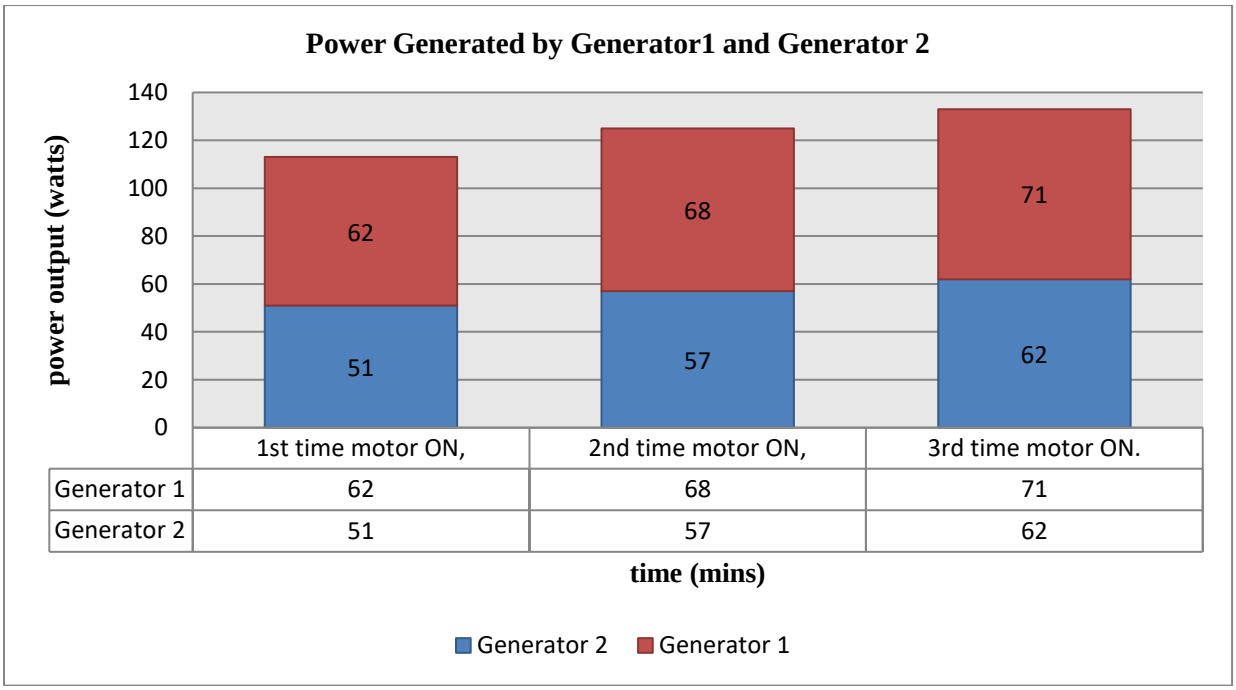

Fig 18: Power generated by the generators at three intervals.

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VI. CONCLUSION

The proposed system has completed successfully. The role of manpower has reduced and the details have been updated on the user. The power generated by the generator 1, generator 2 is displayed and calculated at various time interval. The generated power is intimated to user by an SMS. The graphical representation of power generated at three intervals shown in the graph.

VII. FUTURE SCOPE

The future work will focus on enhancing the performance of the system. The controlling of motor will be done by the user itself. The sensors used in the system will be enhanced to segregate the salt water and drinking water, also purifies the water. This system can give a strong support for the domesticated purposes.

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