# Electricity Generating Water Faucet with Three-Inflow Pipes Generator

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***Abstract*— This study developed a hydro-electric energy device that harvests energy using flowing water which makes the turbine rotate continuously. The device is intended to be used as a water faucet which can be a viable energy source for small appliances rated five volts. It is composed of a generator, turbine, step-down voltage, charger module, rechargeable battery, and volts booster converter. From the different tests conducted, the device was able to generate an average voltage, current, and power of 4.705 V, 399 mA, and 1.877 W, respectively. The power efficiency of the device was 18.77%. The percent charge of the built-in battery increases after an average of 25.5 minutes. The device was able to generate enough power to charge low-voltage devices such as smartphones, power banks, portable lamps, and portable electric fans.**

***Keywords*— generator; turbine; water faucet; power efficiency**

## I. Introduction

As of today, the energy demand remains the same which means it is dramatically increasing and it will rapidly expand with time. Non-renewable energy sources like oil, coal, and natural gases are commonly used in generating energy in power plants. This energy cannot be created nor regenerated as quickly as possible to keep up with its consumption. Moreover, this type of energy is limited and will eventually be gone because of much consumption. Natural resources like non-renewable energy must be conserved and carefully used because the future depends on it [1]. The constantly growing difficulties in power generation using non-renewable energy are very alarming, therefore; renewable energy sources should be advocated. One of the renewable energies that is used in many places today is hydropower. Hydropower represents a green renewable energy source that does not pollute the environment if proper measures are applied [2].

Engineers and researchers have developed alternative solutions to make sure that the supply of electricity is enough for all. They developed machines and devices related to renewable energy which is continuously improving as time has taken over by modernization. Solar, wind, and hydroelectric energy are some forms of renewable energy which is very popular nowadays [3]. Some researchers preferred to use hydroelectric energy [4] before nuclear energy was discovered because it is abundant and it is advantageous to consumers. In the year 1880s, the first hydroelectric power plants were developed, and according to the International Energy Agency (IEA), around 16% of the electricity supply has been developed. This form of renewable energy is more efficient and less risky compared to others. Hydro-electric power can also be applied on a small scale [5] to generate energy which is enough energy to supply some everyday equipment. To generate energy scale hydro-electric power, the water must be in motion which creates a mechanical reaction to the turbines. A simple reaction water turbine with a small diameter can efficiently produce power without having to be large and bulky [2].

This study developed an electricity-generating water faucet that generates energy to supply small devices like smartphones, power banks, portable lamps, and portable electric fans. The device is like a small hydro-electric power plant that has three-inflow pipes linked in the turbine. When water flows from the three-inflow pipes it causes the turbine to rotate and the system will produce a speed needed to generate electricity.

The electric-generating water faucet provides an additional power bank that helps in reducing power consumption. It is a portable device that can be installed in households and offices. Laundry shops and other businesses that continuously use water will greatly benefit since it can be used by them to power up the small voltage devices in their business-like LED lights and smartphones to reduce power consumption. When their power consumption is reduced, they will have more income.

## II. METHODS

### *A. Design and Specification*

The electric generating water faucet is composed of a turbine, generator, DC to DC voltage step-down module, TP4056 charger module, rechargeable battery, and 3.7 volts to 5 volts booster converter as shown in Figure 1. The turbine is run by water inflow coming from three inflow pipes. The output voltage for the generator is 12 volts DC. The DC-to-DC voltage step-down converts the 12 volts to 5 volts so that the intended used which is for small devices rated 5 volts will be achieved. The TP4056 module charges the built-in battery. The built-in battery serves as the storage of power produced by the generator. The booster of 3.7 volts to 5 volts was used to increase the battery's output voltage.

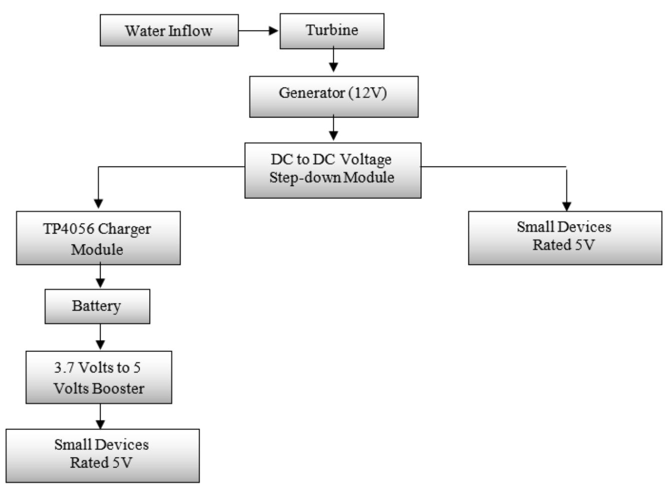


Fig. 1. Block diagram of the device.

The circuit diagram of the electric-generating water faucet is shown in Figure 2. The generated voltage from the turbine which is 12 volts DC is connected through a wire to the DC-to-DC Voltage Step Down module making the generated voltage 5V. Using a USB Micro connector cable, the TP4056 charger module can either be connected to the DC-to-DC Voltage Step Down module to store the collected power to the battery or immediately to a small device rated 5V. The output of the built-in battery is connected to the input of the Volts Booster Converter Module to boost the voltage or improve the voltage for charging small devices rated 5V.

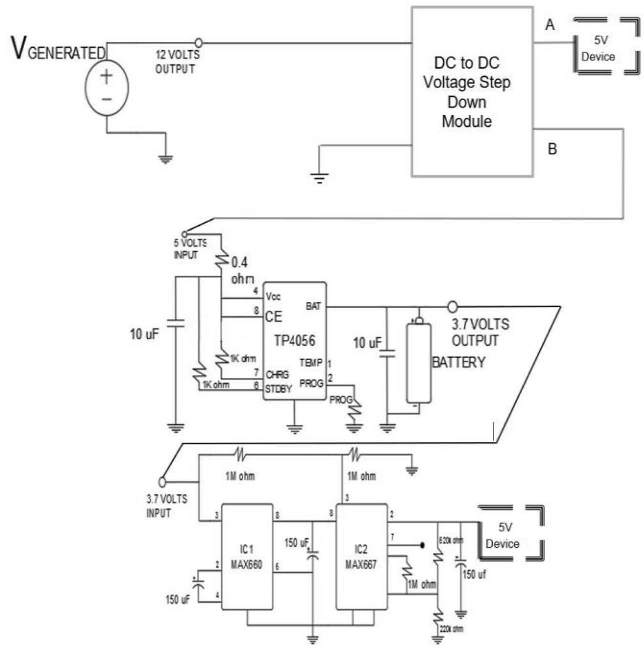


Fig. 2. Circuit diagram of the device.

### *B. Testing and Evaluation*

The efficiency of the device was measured in this study. Power efficiency ($\eta$) is defined as the ratio of the output power divided by the input power [6] as shown in (1). $\eta$ is the efficiency in percent (%). $P_{out}$ is the output power or actual work in watts (W) of the device. $P_{in}$ is the input power consumption in watts (W). In this study, the generator's power rating was rated at 10 watts and this served as the $P_{in}$.

$$\%\eta = \frac{P_{out}}{P_{in}} x\ 100\% \quad (1)$$

The change in charge (CC) from the battery of the device was measured by getting an increase in charge over time (minutes). As presented in equation (2), the previous charge is subtracted from the current charge and then divided to the previous charge. To get a change in charge in terms of percentage, it is multiplied by 100.

$$\%\ \mathrm{CC} = \frac{current\ charge - previous\ charge}{previous\ charge} x\ 100\% \quad (2)$$

## III. RESULTS AND DISCUSSION

The capability of the electric-generating water faucet shown in Figure 4 was tested. It was connected to a water pipe to serve as a faucet. Every 30 seconds the output voltage and current were measured and this was done in 20 trials. After measuring the voltage and current output, the power output and power efficiency are computed. The results are shown in Table I.

Fig. 3. The electricity-generating water faucet with three-inflow pipes generator.

The device was able to generate an average voltage, current, and power of 4.705 V, 399 mA, and 1.877 W, respectively. The average power efficiency of the device is 18.77 %. The highest current produced by the device was measured in the first trial and it varies throughout the trials due to changes in pressure of the water flowing out from the pipelines or faucet.

TABLE I. POWER EFFICIENCY OF THE DEVICE

| Trial | Voltage (V) | Current (mA) | Power (W) | Efficiency (%) |
|---|---|---|---|---|
| 1 | 4.72 | 560 | 2.64 | 26.4 |
| 2 | 4.69 | 480 | 2.25 | 22.5 |
| 3 | 4.71 | 310 | 1.46 | 14.6 |
| 4 | 4.70 | 340 | 1.60 | 16.0 |
| 5 | 4.71 | 310 | 1.46 | 14.6 |
| 6 | 4.69 | 350 | 1.64 | 16.4 |
| 7 | 4.71 | 370 | 1.74 | 17.4 |
| 8 | 4.71 | 400 | 1.88 | 18.8 |
| 9 | 4.71 | 360 | 1.70 | 17.0 |
| 10 | 4.69 | 400 | 1.88 | 18.8 |
| 11 | 4.69 | 350 | 1.64 | 16.4 |
| 12 | 4.70 | 360 | 1.69 | 16.9 |
| 13 | 4.71 | 400 | 1.88 | 18.8 |
| 14 | 4.72 | 450 | 2.12 | 21.2 |
| 15 | 4.70 | 480 | 2.26 | 22.6 |
| 16 | 4.69 | 360 | 1.69 | 16.9 |
| 17 | 4.70 | 430 | 2.02 | 20.2 |
| 18 | 4.71 | 460 | 2.17 | 21.7 |
| 19 | 4.70 | 410 | 1.93 | 19.3 |
| 20 | 4.72 | 400 | 1.89 | 18.9 |

Table 2 shows the change in charge of the built-in battery in the device as time goes by. Initially, the built-in battery has a 50% charge. Every time the power bank charges, the time in minutes is recorded. The percent charge of the built-in battery increases after an average of 25.5 minutes. It can be deemed from the table that the change in charge is directly proportional to time. This means that the device was able to charge the power bank constantly.

TABLE II. CHANGE IN CHARGE OF THE DEVICE

| Trial | Time (min) | Charge (%) | Change in Charge (%) |
|---|---|---|---|
| 1 | 28 | 51 | 2.00 |
| 2 | 52 | 52 | 4.00 |
| 3 | 78 | 53 | 6.00 |
| 4 | 102 | 54 | 8.00 |
| 5 | 125 | 55 | 10.00 |
| 6 | 152 | 56 | 12.00 |
| 7 | 175 | 57 | 14.00 |
| 8 | 201 | 58 | 16.00 |
| 9 | 227 | 59 | 18.00 |
| 10 | 255 | 60 | 20.00 |

The portable micro-hydroelectric generator developed in the device features a three-inflow pipe generator that existing devices [7-8] don't have. The three-inflow pipe will significantly help in the conversion of energy from water flow into electricity. The average voltage of 4.705 V generated by the device is capable of charging devices [9] that connect through USB ports.

## IV. CONCLUSION

This study developed an electric-generating water faucet that was able to generate current which is enough to sustain or to charge small devices rated 5 volts. It can be used to charge smartphones, power banks, portable lamps, and portable electric fans. The device was able to constantly charge the built-in battery within an acceptable period of time considering the size of the turbine used.

The device can be modified and installed in different pipe systems where there is continuous flowing water like irrigation systems and rain pipes. Also, the idea of using three-inflow pipes on the device can further be used in a micro-scale generator that can power up a small community.

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