Design of Picohydro Power Plant for Application of River-based Garbage Lifting Tool IoT

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ABSTRACT: Utilizing water energy can be implemented on small scale, such as with a (PLTPH), which is a small-scale power plant using water as its driving force through a penstock to move a turbine. By applying a river trash lifter based on IoT, the cleanliness of the river environment can be managed. the power source comes from a generator coupled to a Pelton turbine type, which will rotate the generator to produce VAC electricity that will first be converted to VDC voltage so that the voltage is more stable and then converted back to 220 VAC voltage by an inverter. This will become the main energy source for the IoT-based river trash lifter using the Wemos D1 R1 microcontroller as the system's brain to control and collect data from two HC-SR04 ultrasonic sensors, which will be monitored on an LCD display and Telegram notifications. Test results show that water pressure greatly affects the performance of the PLTMH prototype design, with a minimum water pressure required for the PLTMH to work being 18 psi. The generator can produce 60 VAC voltage with an average voltage of 50.05 VAC and an average generator current of 0.046 amps. The power on the generator depends on the voltage and current produced. The load on the generator after being converted to DC current is 9 watts. The duration of the conveyor operation to lift trash from the river to the collection bin depends on the HC-SR04 ultrasonic sensor placed in the river when it detects trash, which will be displayed on the LCD. When the collection bin is full, the HC-SR04 ultrasonic sensor in the collection bin will activate a buzzer, which will be displayed on the LCD and the ThingSpeak.

KEYWORDS: PLTPH, Internet of Things(IoT), Trubine, Generator, Thingspeak

I. INTRODUCTION

One of the most promising renewable energy potentials in Indonesia is the use of water energy. Picohydro, also known as Picohydro Power Plant (PLTPH), is a type of small-scale power plant that uses water energy as its driving force, such as that obtained from irrigation channels, rivers, or natural waterfalls. The way it works is by utilizing the difference in water height (head) and the amount of water flow available. The utilization of river flow is inseparable from environmental cleanliness. It is very important to keep the river clean so that the utilization of river flow can be used optimally [1],[2],[3].

Research that has been done before is the Utilization of Dc Power Plant as a Source of Electricity in Kopo Village Kec. Cisarua with Light Control Via Telegram. Utilization of lamp control via telegram which can turn on or turn off home lighting remotely with the help of the Node MCU ESP8266 module, the source of electricity generated from the generator which is stored in the battery then the voltage from the battery can be used to turn on the 220 v ac lamp, arudino uno, node mcu esp8266, and display [1].

This study aims to design a pico hydro power plant (PLTPH) for the application of an IoT-based river waste lifter. By utilizing the flow of river water as a medium to move the turbine so as to produce mechanical energy and rotate the generator to produce electrical energy and become the main source of power from the IoT-based river waste lifter where Arduino is the brain of the system to control the river waste lifter system. Then the Wemos D1 R2 module as a wifi module to connect equipment components with the internet network then forwarded to the Smartphone to detect garbage on the surface of the river and monitor garbage in the reservoir. By using the thingspeak platform to monitor the river waste lifting tool.

II. OVERVIEW

A. PLTPH

PLTPH is a small-scale power plant that produces electrical energy less than 500 W. Hydroelectric power plants have the principle that it is a form of energy change, in this case hydropower with a certain discharge and height into electric power, by utilizing turbines and generators to produce electricity. The principle in picohydro scale hydropower is to utilize the difference in height and the amount of water discharge per second in the river flow, then the water flow will drive the turbine, then the turbine transmits the rotation to the generator so as to produce electricity. small power generation system that uses water with low discharge as its energy source. The water utilized can come from irrigation canals, rivers, or natural waterfalls. In general, EHP consists of three main components, namely water, water turbine, and generator. Water discharge and height difference (head) are important factors in producing energy, both in the form of mechanical and electrical energy [4].

The classification of hydropower plants can be seen in table 1 below [5].

Tbl 1. Classification hydropower

No	Type	Capacity
1	Pico hydropower	< 500 W
2	Micro hydropower	0.5-100 kW
3	Mini hydropower	100-1000 kW
4	Small vhydropower	1 MW-10 MW
5	Fullscale hydropower	> 10 MW

B. GENERATOR

Generator A generator is a device that converts mechanical energy into electrical energy through electromagnetic principles. Basically generators have 2 types, namely AC generators and DC generators, AC (Alternating Current) Generators are machines which are used to produce AC (Alternating Current) electrical energy or produce alternating electric current, and this ac generator has 2 cables with positive and negative poles. With the difference in cables allowing the two ends of the kumpara will not be connected to each other, because it is only connected with 1 slip ring only. Direct current (DC) generators work with the basic principle of electromagnetic induction first discovered by Michael Faraday. This principle is known as Faraday's Law of electromagnetic induction, which states that if an electrical conductor moves in an arbitrary magnetic field, an electromotive force (EMF) or electric voltage will be induced in the conductor" [6].

C. TURBINES

Turbines that use the working fluid of water. Water turbines use the high potential energy of water, which comes from water flowing from a high place (such as a lake or dam) to a low place (a waterway or river). The water flows through a closed channel or pipe towards the turbine. During this flow process, the potential energy of the water (its height) turns into kinetic energy as the speed of the water increases with decreasing height. The working principle of a turbine is that when water enters the turbine, it flows into parts called nozzles or funnels, where it is accelerated before entering the turbine wheel [7]. The rotation of the turbine wheel is the essence of energy conversion in a water turbine. When water hits the turbine wheel, the kinetic energy of the water is converted into mechanical energy. The rotation of the turbine wheel generated by the water flow drives the turbine shaft. This shaft is connected to an electric generator, which converts mechanical energy into electrical energy. This principle utilizes the basic principles of physics, where the kinetic energy of the fluid flow (water) is converted into mechanical energy by rotating the turbine wheel. The turbine wheel usually has angles designed to capture the energy from the water flow efficiently. Water turbines are used extensively in hydroelectric power generation, which is a renewable and environmentally friendly source of energy. They are also used in other applications such as irrigation, industry, and water distribution [8].

D. BATTERY

A battery is an electrochemical cell that can convert chemical energy into electrical energy, where the process in it takes place reversibly (can be reversed) with high efficiency. As for what is meant by reversible electrochemical reactions is the process of converting chemistry into electric power (discharge process) and vice versa from electric power converted into chemistry (charging process), namely by regenerating the electrodes used, namely by passing an electric current in the direction of the opposite polarity in the cell [9].

E. INTERNET OF THINGS (IOT)

The Internet of Things, also known by the acronym IoT, is a step forward from the internet that creates a world infrastructure that connects machines and people. When the Internet became public in the early 1990s, the first wave of exploitation and deployment focused on the impact on everyday services and applications that changed the known models for financial transactions, shopping, and information sharing. advances in communication technology. the use of the Internet at home and at work constitutes a sophisticated interconnection with machines [10], [11].

F. WEMOS D1 R2

Wemos is an Arduino compatible development board specifically designed for IoT (Internet of Thing) purposes. Wemos uses a wifi SoC chip that is quite famous today, namely ESP8266. Quite a lot of Wifi modules use SoC ESP8266. The following is the shape of the Wemos D1 R2 which can be seen in Figure 1 below [12]:

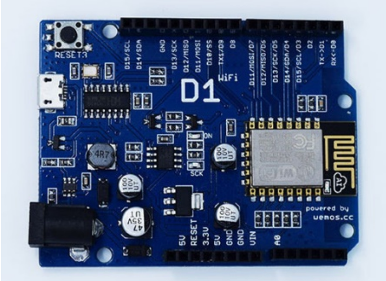

Fig 1. Wemos D1 R2

G. ARDUINO IDE

Arduino IDE is a development environment specifically designed to facilitate application development using the Arduino platform.Text Editor: Used to write Arduino program code in the C/C++ programming language. This editor is equipped with features such as syntax highlighting to make code reading easier, as well as code hinting to display suggestions and documentation while typing. The message area is used to display important information, such as error messages, status information when compiling or uploading the program, and debugging information if any [13].

H. HCSR-04 TYPE ULTRASONIC SENSOR

The HCSR04 type ultrasonic sensor is a device with the use of a distance mechanism from an object. The ultrasonic sensor produces ultrasonic waves with a frequency of about 40 kHz after the ultrasonic waves reach the object, it bounces back to the sensor as an echo wave [14].

I. DC MOTOR

An electric motor of the DC type or DC motor is a motor that requires a DC (direct) current voltage input to the coil of the medium which will be converted into mechanical motion energy. The coil can be called the stator or non-rotating part and the rotating part or anchor coil is called the rotor [15].

J. DRIVER MOTOR *L 298 N*

The most widely used motor driver module or DC motor driver is the L29N type motor driver. Where this motor module functions as a speed controller and direction of rotation of a unidirectional motor. To control components such as solenoids, relays, stepper motors and DC motors, an IC L298 is needed, which is an H-bridge type IC that can control more than one inductive load. Inside the IC there are TTL or logic transistors with NAND gates which will be tasked with making it easier to determine the direction of rotation of the motor [16].

K. WATTMETER DIGITAL

Wattmeter has the main components of the current coil and voltage coil, so the installation is the same, namely the current coil is installed in series with the load and the voltage coil is installed parallel to the voltage source. Wattmeter can be applied to measure power on direct current (DC) and alternating current (AC) sources [17].

L. LIQUID CRYSTAL DISPLAY (LCD 16X2) WITH I2C

LCD (Liquid Crystal Display) is a very useful component in electronic systems that use microcontrollers. An LCD display consists of two sheets of polarizing material that have a layer of liquid crystals in between. When a voltage is applied to the liquid crystal layer, the crystals can be set to either emit light or block it. This allows the formation of characters or images that are displayed [18].

M. PLATFORM THINGSPEAK

Thingspeak is an application platform and open-source API for the internet of things (IoT) that is used to store and retrieve data from devices using the HTTP protocol over the internet. The thingspeak platform is useful for displaying and storing data sent by microcontrollers in real-time, and works as long as a good internet connection is maintained. To use thingspeak, users must create an account and channel [19].

N. HOW THE WHOLE DEVICE WORKS

The workings of this tool system, which are arranged in such a way as to design a Picohydro Power Plant system where it starts from the flow of water entering the reservoir which serves to maximize the water pressure that will be flowed to rotate the turbine through the rapid use of a generator that serves to generate electricity and will be displayed on an AC wattmeter which displays the power, current, and voltage of the generator which is stepped down first using a CT transformer to stabilize the voltage and enter the DC wattmeter which displays the current, voltage and power generated, and is stored in the battery battery to become a source of electricity from the automatic river trash lifter.

In the IoT-based River garbage lifting system where the system is controlled using a Wemos D1 R2 microcontroller which aims to facilitate the control and monitoring of garbage in the River using the thingspeak platform. where the electric power source from the PLTPH will be the electricity supply for automatic River garbage lifters using 5VDC power for microcontrollers and 12 VDC for servo motors as conveyor drives. In this garbage lifting system uses 2 HC-SR04 Ultrasonic sensors to detect garbage in the River and the catch basin. Ultrasonic sensor 1 detects garbage in the river and will turn on the servo motor as a conveyor drive to lift the garbage to the catch basin and will be displayed on the LCD as well as on the thingspeak platform to monitor the garbage in real time. Ultrasonic sensor 2 to detect garbage in the catch basin When the catch basin is full the HC-SR04 ultrasonic sensor will detect and turn on the buzzer then

displayed on the LCD and on the thingspeak platform for full catch basin notification.
The schematic design of the tool can be seen in Figure 2.

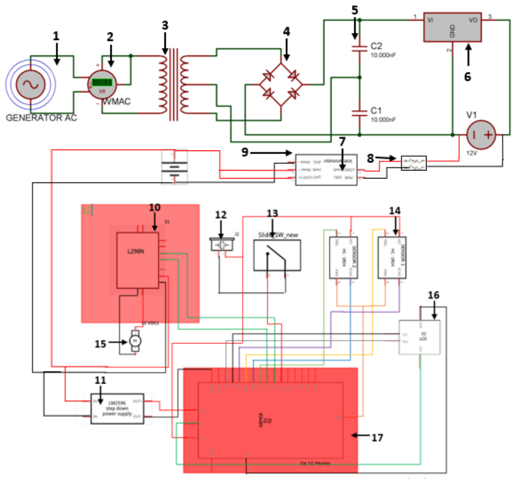

Fig 2. Framework Design

O. Tool Shape Design

The realization of the PLTPH design for the application of IoT-based river lifters using pelton turbines where this PLTPH design has several components, including: pelton turbine, iron frame, PLTPH modeling, pulley connecting pelton turbine, generator, acrylic box as a water reservoir and garbage collection tub, pipe that serves to drain water, pump that functions to regulate the entry and exit of water through the pipe, AC and DC wattmeters, turbine housing, power suplly, AC and DC MCBs, inverters, sockets, DC motors, IoT-based River Garbage Lift Circuit.

The shape of the tool can be seen in Figure 3 below:

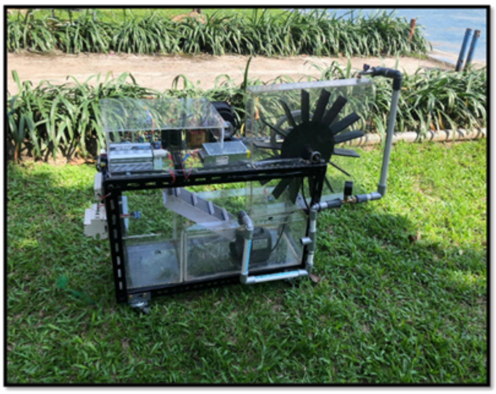

Fig 3. Tool Form

P. Planning Of River Trash Lifting Equipment

In the planning of the River Garbage Lifting Tool aims to find out the application of the tool directly.
The visual design of the planning can be seen in Figure 4.

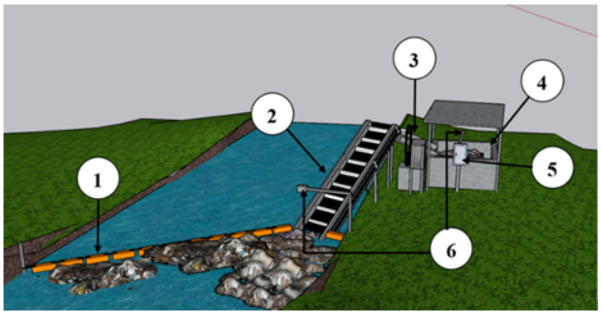

Fig 4. Planning Of River Trash Lifting Equipment

III. Research Methods

In this final project research, the following research methods were used:

1. Designing a prototype of Picohydro Power Plant for the Application of IoT-Based River Garbage Lifters.
2. Testing the Picohydro Power Plant and IoT-based river waste lifter to find out whether the tool is in accordance with what is desired.
3. Adjustment of placement and use of tools during testing.
4. Data analysis of test results from tools in adjusted conditions.
5. Identify and evaluate the performance of the Picohydro Power Plant prototype under appropriate conditions or not, and draw conclusions based on the results of the study for understanding and taking appropriate action.

IV. Result And Discussion

A. Installed Load

In testing using a water pump to determine the effect of water pressure in the form of PSI (Per Square Inch) and without the load from the River garbage lifter, several tests of the effect of water pressure on water discharge, turbine rotation, generator rotation, generator voltage, and generator current, and generator power. The following is the overall generator load can be seen in table 2 below:

Tbl 2. Installed Load

No	Load	Power (Watt)
1	wemos d1 r1	0,33
2	Ultrasonic sensor	0,11
3	LCD 16x2 I2C	0,11
4	buzzer	0,05
5	DC mOTOR	7,2
	Load	7,8

The load when the generator is converted to DC voltage is 1.2 watts so the overall load on the generator is 9 watts.

A. Water Pressure Testing on Water Discharge

Measurement of water discharge using water reservoirs, in measuring water discharge using a water reservoir box with a capacity of 23 liters. This water discharge measurement is adjusted to the given water pressure setting. The pump used in this PLTPH modeling has a pressure between 0 psi and 40 psi. measurement of water pressure using a pressure gauge. In this water pressure setting there are 10 setting positions on the pump, where the minimum pressure used is 10 psi and the maximum pressure is 40 psi. Which aims to determine the volume of water in units of time, calculating water discharge using the following equation 1:

$Q = \frac{V}{t}$ (1)

$10\ psi = \frac{23\ liters}{143{,}36\ s} = 0{,}16\ L/s$

The following are the results of the test which can be seen in table 3 below:

Tbl 3. Water discharge testing results

No	Water pressure(psi)	Water Discharge(L/S)
1	10	0,16
2	15	0,19
3	18	0,19
4	20	0,24
5	25	0,29
6	28	0,32
7	30	0,34
8	35	0,36
9	38	0,4
10	40	0,44

It can be seen that the water discharge increases along with the increase in water pressure. The greater the water pressure applied, the greater the volume of water produced. The lowest water discharge at 10 psi water pressure is 0.16 liters/second while the highest water discharge at 40 psi water pressure is 0.44 liters/second.

B. Water pressure testing on turbine rotation

Water pressure testing of turbine rotation is carried out to determine the turbine rotation generated from the incoming water pressure, using a tachometer to measure turbine rotation (RPM) in two conditions, namely without coupling to the generator and coupled to the generator. The following are the results of the test which can be seen in table 4 below:

Tbl 4. Turbine rotation test results

No	Water Pressure	Turbine rotation (RPM)	Coupled Turbine Rotation Generator(RPM)
1	10	121	51
2	15	140	68
3	18	250	120
4	20	289	136
5	25	290	145
6	28	387	198
7	30	402	208
8	35	421	215
9	38	487	328
10	40	501	350

The effect of water pressure on turbine rotation is that the increase in pressure exerted on the turbine will cause an increase in turbine rotation speed. the greater the thrust of the water then hits the turbine so that it rotates. When the turbine is coupled to the generator, the turbine speed decreases, because the turbine gets an additional workload to rotate the generator. The highest turbine rotation speed before coupled to the generator occurs when the water pressure is 40 psi, which is 501 RPM (Rotations Per Minute). While the lowest turbine rotation speed without being coupled to the generator occurs when the water pressure is 10 psi at 121 RPM. The highest turbine rotation speed after being coupled to the generator occurs when the water pressure is 40 psi, which is 350 RPM (Rotations Per Minute). While the lowest turbine rotation speed after being coupled to the generator occurred when the water pressure was 10 psi at 51 RPM.

C. Water Pressure Testing on Generator Turns

Water pressure testing of generator rotation is carried out to determine the rotation of the generator generated from the turbine rotation using a tachometer to measure the generator rotation (RPM). The following are the results of the test which can be seen in table 5 below :

Tbl 5. Generator rotation test results

No	Water Pressuer (psi)	Generator Rotation(RPM)
1	10	245
2	15	326
3	18	576
4	20	653
5	25	696
6	28	950
7	30	998
8	35	1.032
9	38	1.575
10	40	1.680

Based on the water pressure testing of the generator, the highest generator rotation speed occurs at 40 psi water pressure which is 1,680 RPM. While the lowest generator rotation speed occurs when the water pressure is 10 psi, which is 245 RPM. The generator rotation speed is directly proportional to the turbine rotation speed which is influenced by water pressure.

D. Testing Water Pressure against Generator Voltage

In testing water pressure on generator voltage, it is carried out to determine the effect of water pressure on the voltage produced by the generator which will be displayed on the AC wattmeter and DC wattmeter for the voltage produced. With an installed load of 9 watts. The following are the results of the test which can be seen in table 6 below:

Tbl 6. Generator voltage test results

No	Water Pressure (psi)	Generator voltage (VAC)	After Converted (VDC)
1	10	15	0
2	15	17	0
3	18	27	4,6
4	20	30	5
5	25	34	6
6	28	38	7
7	30	43	9
8	35	47	10,4
9	38	58	12,2
10	40	60	12,4

Based on the water pressure testing of the generator in Figure 4.6, the maximum voltage produced by the generator at 40 psi water pressure is 60 VAC, while the lowest voltage produced by the generator is 15 VAC at 10 psi water pressure. The minimum voltage of the generator when converted is 4.6 VDC at 18 psi water pressure. And at 10 psi and 15 psi water pressure has a conversion voltage of 0 not read on the DC wattmeter display, this is because the water pressure given is not able to meet the minimum standard of generator rotation to produce voltage to be converted to VDC.

E. Testing and analyzing water pressure against generator current

In testing water pressure against generator current, it is carried out to determine the effect of water pressure on generator current. The following are the results of the test which can be seen in table 7 below:

Tbl 7. Generator current test results

No	Water Pressure (psi)	Generator Current (*Ampere*)
1	10	0
2	15	0
3	18	0,04
4	20	0,05
5	25	0,1
6	28	0,1
7	30	0,2
8	35	0,2
9	38	0,2
10	40	0,2

Based on testing water pressure on generator current with an installed load of 9 watts has a maximum current of 0.2 amperes from 40 psi water pressure and a minimum of 0.04 amperes at 18 psi water pressure. At 10 psi and 15 psi water pressure has a current of 0 amperes, this is because the water pressure given does not meet the minimum standard to be converted to VDC .

F. Testing and analysis of water pressure on generator power

In testing water pressure on generator power, it is carried out to determine the effect of water pressure on the power produced by the generator. With an installed load of 9 watts The following are the results of the test which can be seen in table 8 below:

Tbl 8. Generator power test results

	Water Pressure (Psi)	Generator Power (Watt)
1	10	0
2	15	0
3	18	1,08
4	20	1,5
5	25	3,4
6	28	3,8
7	30	8,6
8	35	10,4
9	38	11,6
10	40	12

Based on testing water pressure on generator power, the maximum power generated is 12 watts at 40 psi water pressure and the minimum power is 1.08 watts at 18 psi water pressure.

G. Hydropower Testing and analyzing on the river

The results of the PLTPH Generator test with an installed load of 9 watts. The following are the results of the test which can be seen in table 9. following:

Tbl 9.Hydropower test results on the river

No	Voltage AC Generator (volt)	Current Generator(A)	Power Generator (watt)	Voltage Konversi (VDC)
1	43	0,2	8,6	9

2	44	0,2	8,8	9,6
3	47	0,2	9,4	10,4
4	48	0,2	9,6	10,8
5	49	0,2	9,8	11,6
6	50	0,2	10	12,2
7	52	0,2	10,4	12,3
8	54	0,2	10,8	12,4
9	58	0,2	11,6	12,4
10	60	0,2	12	12,8
rata-rata	50,5	0,2	10,1	11,35

From the test results in Figure 4.10 the maximum current in the generator is 0.2 amperes, the minimum voltage of the generator is 43 VAC and the conversion voltage is 9 VDC with the power generated by the generator is 8.6 watts. The maximum voltage of the generator is 60 VAC and the conversion voltage is 12.8 VDC with 12 watts of power. In this test the PLTPH generator produces an average power of 10.1 watts.

H. Calculation of Battery Capacity and Battery Charging

Calculation of battery capacity aims to estimate the amount of power needed for backup according to the load used in the River garbage lifting tool. The following are the results of the test which can be seen in table 10. following:

Tbl 9. Generator current test results

Part	Load (Watt)	t (hour)	Energy (Wh)
ESP8266	0,33	8	2,64
Motor DC	7,2		57,6
Modul *stepdown*	0,018		0,144
Buzzer	0.46		3,68
Sensor Ultrasonik	0,1		0,8
LCD 16x2 I2C	0.1		0,8
Total	7,648 Watt		65,664(Wh)

To find out the battery capacity needed to power the installed load as in the table with a total energy requirement of 65.664 Wh, it is necessary to find the battery charge using equation 2 following:

$$Q_{battery}\ (Ah) = \frac{Wh}{V_{op}} = Ah \ (2)$$

$$Q_{\ battery} = \frac{65{,}664}{12}$$

$$Q_{\ battery} = 5{,}55Ah \approx 5.550\ mAh$$

From the calculation results obtained 5.55 Ah, so the load requirement for 8 hours with a total load of 65.664 wh requires a battery with a capacity of 5,550 mAh. From the above calculations, a battery of 5,550 mAh is required. The use of the battery will not be left until it runs out to prevent damage to the battery. Generally, the DoD (Depth of Discharge) level only reaches 80% and will not be spent until 100% of the battery capacity. DoD calculation can be seen in equation 3. following :

$$C_{battery} = \frac{Q_{battery}\ x\ t_{autornomy}}{DOD\ battery} \ (3)$$

$$C_{battery} = \frac{5{,}55\ Ah\ x\ (1x8hour)}{0{,}8}$$

$$C_{baterai} = 6{,}9\ Ah$$

For 8 hours of battery usage with a load of 7.648 with a DoD (Depth of Discharge) of 80% the required battery capacity is 6.9 Ah. So that with a total battery of 8 Ah will not be used until it is completely discharged 0%. Since the battery serves as an energy source to supply the load, over time, the battery power will be drained. To estimate the duration of time required to turn on the load starting from a fully charged battery condition until it runs out. Using the following equation 4.:

$$Estimated\ discharge\ timeEstimated\ discharge\ time$$
$$= \frac{Battery\ capacity\ x\ battery\ voltage}{Efficiency\ x\ load\ used} \ (4)$$

$$Estimated\ discharge\ time = \frac{8\ Ah\ x\ 12\ V}{80\%\ x\ 7{,}648\ W} = 15{,}6\ hours$$

From the results of the above calculations, a battery with a capacity of 8 Ah 12 Volts with a load of 7.648W can supply power to the load for 15.6 hours.

I. Testing and Analysis of River garbage lifter

In testing and analyzing the HC-SR04 ultrasonic sensor river garbage lifter (river), it is carried out to determine the performance of the sensor to detect garbage in the river. The following are the results of the test which can be seen in table 10 below:

Tbl 10. Test results of HC-SR04 Ultrasonic Sensor Testing (river)

no	distance (cm)	duration the sensor detects	conveyor working duration
1	5	2	5
2	5	3	8
3	5	3	8
4	5	2	5
5	5	4	10
6	5	2	5
7	5	4	10
8	5	4	10
9	5	4	10
10	5	2	5

Based on sensor testing on the River, the duration of the conveyor working depends on the duration of the sensor detecting the presence of garbage, the longer the sensor detects garbage, the longer the conveyor will work.

In testing the HC-SR04 ultrasonic sensor (container), it is carried out to determine the performance of the sensor to detect garbage in the garbage container, where the volume of the garbage container is 11,550 cm3. Here are the results of the test which can be seen in table 11. following:

Tbl 11. Test results of HC-SR04 Ultrasonic Sensor Testing (Container)

No	Waste Volume (Cm^3/S)	Duration the catch basin is filled (Minute)	Catch Basin Sensor
1	19,25 cm^3/s	10 Minute	Full
2	21,4 cm^3/s	9 Minute	Full
3	24,06 cm^3/s	8 Minute	Full
4	27,5 cm^3/s	7 Minute	Full
5	32,75 cm^3/s	6 Minute	Full
6	38,65 cm^3/s	5 Minute	Full
7	48,13 cm^3/s	4 Minute	Full
8	64,16 cm^3/s	3 Minute	Full
9	92,91 cm^3/s	2 Minute	Full
10	192,5 cm^3/s	1 Minute	Full

Based on the test results where the volume of garbage is getting bigger, the catch basin will be filled faster and the sensor will detect that the garbage is full in the catch basin within a certain period of time depending on the volume of garbage entering the shelter.

V. CONCLUSIONS

From the results of testing and analysis that has been carried out on the realization of the design of PLTPH for the application of IoT-based river lifters, it can be concluded as follows :

1. The measurement results of the PLTPH design were carried out. The maximum voltage produced by the generator is 60 VAC with a current of 0.2 Amper and the power produced is 12 watts.
2. Turbine rotation is very dependent on the water pressure given where the greater the water pressure the faster the turbine rotation produced. When the turbine is coupled to the generator, the turbine rotation will slow down even more, it is because the turbine has an additional workload. the minimum water pressure required to drive the turbine is 10 psi.
3. The generator rotation depends on the turbine rotation where the minimum generator rotation to produce the voltage needed for the device to work is 576 RPM.
4. In the design of the MHP, the minimum water pressure so that the MHP can operate is 30 psi with the resulting voltage of 43 VAC. These results can be converted to VDC with a voltage obtained of 9 VDC with the resulting power of 8.6 watts.
5. The water discharge of the twin stone river in Cidereum Village is in the range of 4.86 m3 / s, with water pressure ranging from 30 psi to 40 psi depending on the condition of the river flow water discharge.
6. Direct testing in the river gets the value of the average generator voltage generated is 50.5 VAC, the average generator conversion voltage is 11.8 VDC, with the maximum generator current is 0.2 amps, the average power generated by the generator is 10.1 watts.
7. The difference in generator usage load at a minimum voltage of 43 VAC is 0.4 watts less than the installed load so that the garbage lifter does not work optimally and at a voltage of 60 VAC the difference in load is more than 3 watts so that the garbage lifting system works optimally.
8. Garbage will be detected by the sensor at a distance of 10 cm which will be lifted to the shelter by the conveyor, the duration of the conveyor working is influenced by the duration of the sensor detecting garbage. Waste monitoring is on the LCD display and thingspeak platform where waste monitoring can be done in real time.

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AUTHOR BIOGRAPHY AND CONTRIBUTIONS

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Adalah seorang sarjana teknik yang telah menyelesaikan studi pada Program Studi Teknik Elektro di Universitas Pakuan. Lahir di Lebak, 05 Juni 2001. Yang juga aktif dalam kegiatan organisasi kejuruan yakni Himpunan mahasiswa Teknik Elektro Universitas Pakuan. Dalam penelitian ini penulis berkonsentrasi pada perancangan untuk alat yang bermanfaat dan mudah dipahami dengan memanfaatkan Internet of Things (IoT) dan energi terbarukan.