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Design of River Flow Floating Portable Micro-Hydro

Parea Rusan Rangan[1], Andrea Stevens Karnyoto[2], Yusri Anugerah Manapa Ambabunga[3], Abedneigo Carter Rambulangi[4]

1(Teknik Sipil, Fakultas TeknikUniversitas Kristen Indonesia Toraja, Tana Toraja)
2 (Teknik Informatika, Fakultas Teknik Universitas Kristen Indonesia Toraja)
3 (Teknik Elektro, Fakultas Teknik Universitas Kristen Indonesia Toraja)
2 (Manajemen, Fakultas Ekonomi Universitas Kristen Indonesia Toraja)

Abstract:

The river flow can convert to electrical energy as the renewable-energy source. Indonesia is one of a country has many rivers; however, for now, river flow that used as renewable energy is very least. Therefore, researchers have designed floating portable micro-hydro that is easy to develop by conventional people or rural people. It also uses easily obtained of materials. The micro-hydro intended to use low-priced materials; however, low RPM(Radius per Minute) generator is still expensive because it imported from another country. The floating portable micro-hydro will have other several advantages. That is, ability to adjust to the water surface, enabled to move around, easy installation, and it is maintainable. We expected for common people could be motivated to develop maintainable simple micro-hydro.

Keywords **— Environmentally Friendly, Floating, LOW RPM Generator, Micro Hydro, Portable, Renewable Energy, River Flow, Turbine, Water Flow Energy.**

I. INTRODUCTION

Indonesia is one of a country has many rivers. Indonesia consists of 515 regencies. Many of this regency is in mountain areas and have rivers that flow throughout the year. According to rivers data from Central Agency on Statistics Indonesia in 2015, many rivers in Indonesia have high water discharge. For example, Sa'dan river locate in North Toraja regency of South Sulawesi province, river flow area (km2) is 5,985.0 km, and highest water discharge is 1,156.7 m3. The high water discharge is potential to convert from river flow energy into electrical energy. Small hydro-power plants and micro-hydro power plants have acquired increasing attention due to their ecological irreproachability and acceptable prices for generating available electricity without producing harmful unexpected pollution and greenhouse gases [6]. The hydroelectric power plant has several advantages, that is, cost of hydroelectric power is relatively low; it makes a competitive source for renewable energy, and the hydroelectric power plant does not consume water, in contrast to coal or gas power plants.

people to develop micro-hydro is insufficient. Indonesian people are still inexperienced for micro-hydro technology because they never involved directly in making the micro-hydro power plant. Successful isolated rural micro-hydro systems usually have one thing in common: a competent, resident, on-site operator [4]. Lack of funds to build the hydroelectric power plant is also one of the obstacles. The villagers are also characterized by their low economic income [3]. Maintenance is a problem that includes training, technical and organisational skills, communication and accessibility. Currently, development of micro-hydro turbines considered expensive and unreachable because it needs the specific spare parts, requiring infrastructure development, spare parts are difficult to find in the market so the prices become costly, and maintenance requires specialized knowledge. On the other hand, many people who live in mountain areas not enjoyed electricity, although they are living near the rivers. The researcher's contribution to designing hydroelectric power plant using spare parts whose primary materials easily found throughout Indonesia is urgently needed.

The renewable energies, especially hydro-power, are a growing market facing the challenge to supply

the world's increasing electric power demand [5]. Hydro-power is one of the most important renewable energy sources, with an amount of 3,402 billion kilowatt/hours electricity generation in 2010, expected to increase about 83% from 2010 to the year 2040 [1].

The river flow floating portable micro-hydro is one of the solutions. There is one certainty when designing and installing self-help micro-hydro systems in remote areas-this is that the problems will be many and varied [4]. Micro-hydro is power plants which are converted rivers flow energy to twist energy by the turbine and then twist energy convert to electric energy by a generator. The non-dam hydro technology has no need for constructing a dam, which could have drawbacks regarding the ecology in some areas [5]. The ability to float make micro-hydro can adjust the river's surface elevation. Micro-hydro designed to portable size so it easy to move around. With these capabilities will make micro-hydro easily during the installation process, the installation requires small human resources, river structure changes not needed, and easy to maintenance.

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II. THE DESIGN

To create a river flow floating portable micro-hydro. First, every component produced one by one. Next, unified to become a complete unit. This device consists of several components, viz:

A. Buoys

Buoys are used to make the micro-hydro have the ability to float. Buoys made from PVC pipe material. The diameter of PVC pipe is 10 cm, thickness 1.2mm, and the length is 100 cm. PVC pipe arranged in parallel as much as two upwards and eight to sides so it can float for the 100 kg load.

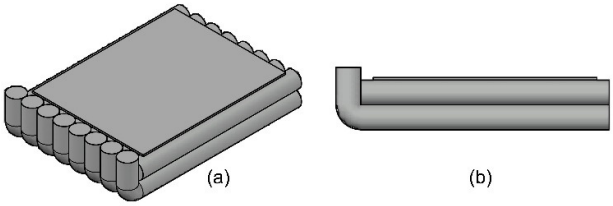

Figure 1. The buoys

In figure 1 show at the front of the buoy is connected the other pipe using the elbow to form a 90-degree angle. The 90-degree vertical tube is useful to withstand collisions from other hard objects floating on the surface of the river.

B. Buckets

All Buckets are used to capture the flow of river water and convert it into twist energy. Buckets are designed like the Pelton; when the water comes to hit the turbine, it gets trapped and push the turbine. The Pelton turbine consists of specially shaped buckets [2]. Water in the form of a jet impinges on the central splitter and divides into two equal streams before leaving the bucket in a direction opposite to that of the incoming jet [2]. This Bucket Frame made from the iron rod and bucket walls made from aluminum plate material. The diameter of the iron rod is 10 mm.

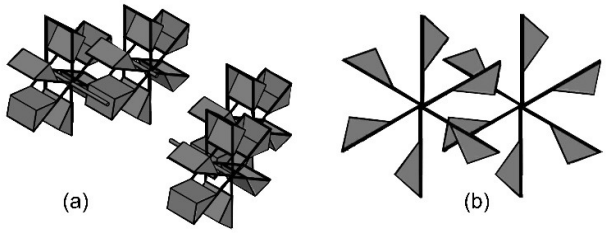

Figure 2. Turbine Buckets

Figure 2 shows the bucket on a turbine that is used to convert the rivers flow energy into twist energy. The diameter of the turbine is 100 cm. The micro-hydro consists four turbines so it can increase the thrust of water to the turbine. Every turbine is connected each other.

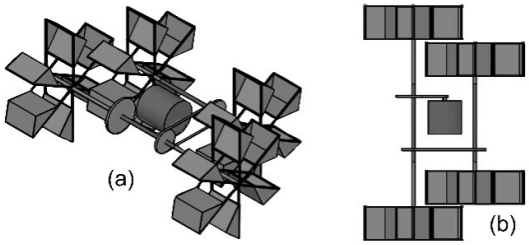

Figure 3. Turbine Position

Figure 3 shows on a micro-hydro have four turbines, and turbine position is not parallel on the front with the back of micro-hydro. The turbine in the rear is made further away from the micro-hydro body so that each turbine gets the same water velocity.

C. Chain or Belt

To connect between the front axle and rear axle using chain/belt is required. It will increase turbine capability for thrust of water. Chain/belt is also was using to connect rear shaft and rotor of generator. This floating portable micro-hydro has four turbines used to rotate the rotor of a generator. Aligning the rotation of the front turbine and rear turbine should use the same poley size.

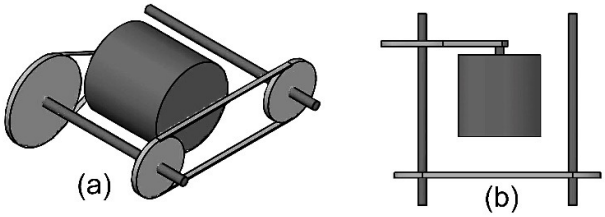

Figure 4. The connection between chain/belt, rotor, and generator

From figure 4 shows that to connect between the front axle and rear axle was using chain/belt. The connection between the left turbine and right turbine was using the iron pipe.

D. Body Frame

The body frame was using to buffered all components such as generators, turbines, shafts, and casing of the body.

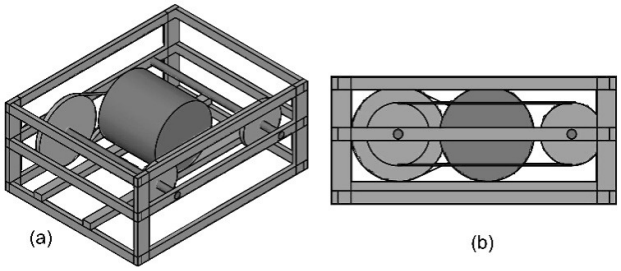

Figure 5. Body Frame

From Figure 5 shows that the frame was made simple. We are using welding to create the frame. The welding was chosen because it makes the frame more permanent and not shake easily. This frame will be placed above the buoy as seen in figure 6.

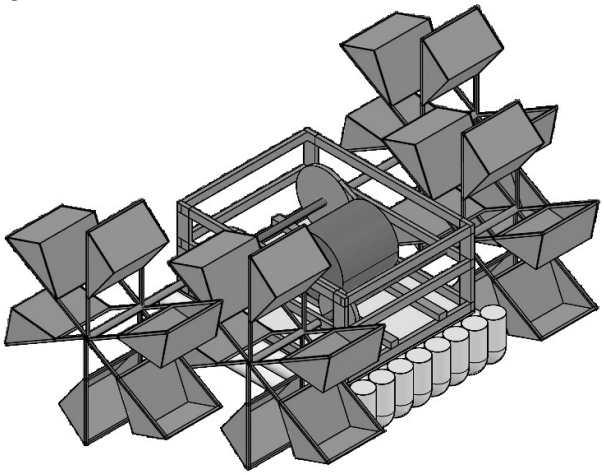

Figure 6. Frame Position

Figure 6 shows the connection between the frame and other components. The function of frame is as a buffer, as a cradle placed above the buoy and as a frame for casing.

E. Generator Low RPM

The essential components of hydro-power are turbines and generators, the function of turbines is converted the potential energy of water to the twist energy, and the generator converted it into electrical power. The axis generator or the so-called rotor will rotate, the rotation will bypass the magnetic force line from the stator to produce electric motion induction.

Currently, green energy technology was very advanced, so it is easy to get a generator with the right specification for micro-hydro power plant

development. This floating portable micro-hydro design was using the low-RPM generator.

Figure 7. Generator Low RPM

The floating portable micro-hydro was utilizing a generator with permanent magnet generator. The specifications of the generator that is, small size, easy installation, rotor using a patented alternator, low RPM (300 rpm for maximum wattage).

F. Casing

Casing function is to protect the component such as chain/belt and generator against water and sunlight. Casing made from aluminum plate. The thickness of the aluminum plate is 0.3 mm. Several advantages of the aluminum plate are lightweight, resistant to rust, and easy to find in the market.

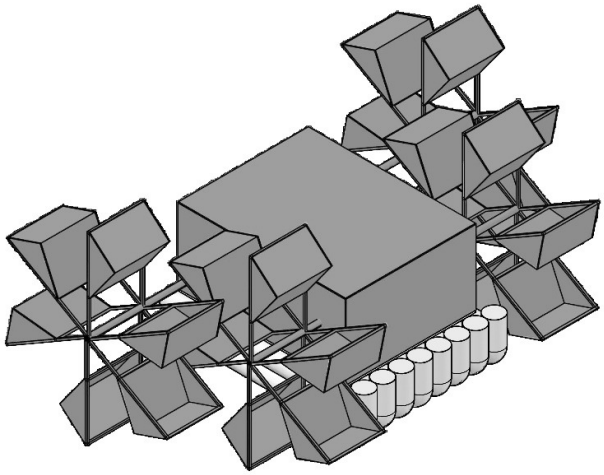

Figure 8. Casing Position

Figure 8 shows the casing of a floating portable micro-hydro. It protects the components such as generator, poley, and chain/ belt against water and sunlight. The components that on outside of turbine body are only turbines and buoys because these parts are directly affected by river flow.

G. Expected Flotation

The expected buoyancy of the turbine to work as well is about 20 cm from the lower ends of the turbine.

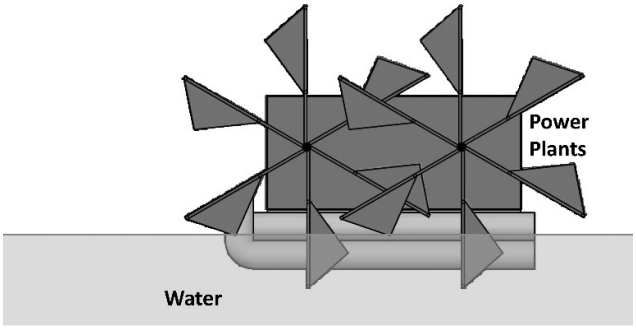

Figure 9. Flotation of floating portable micro-hydro

Figure 9 shows that floating portable micro-hydro is expected to work best if the bottom of the turbine bucket is partially submerged in water when the bucket position is at the bottom of the turbine.

H. Installation of Floating Portable Micro-hydro on River

Easy installation makes common people can install it directly on the flowing river.

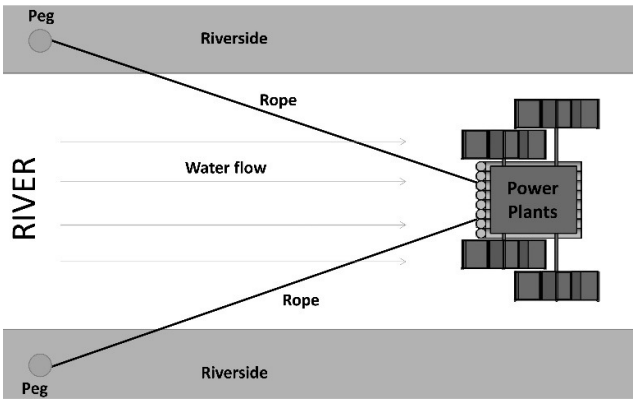

Figure 10. Position floating portable micro-hydro in the river

From Figure 10 can be seen the position of floating portable micro-hydro on the river. Additional components for installation are pegs, and ropes and cables. Pegs is planted on the

riverside, the function of pegs are kept the floating portable micro-hydro turbine not being carried away by the water flow. The rope is used to connect between the floating portable micro-hydro and pegs; the other function of rope is to keep the floating portable micro-hydro adjust against water elevation of the river. Cables are used to connect electrical currents from floating portable micro-hydro to electrical equipment.

I. Electrical Installation

To connect from floating portable micro-hydro to electrical equipment require cable and stabilizer.

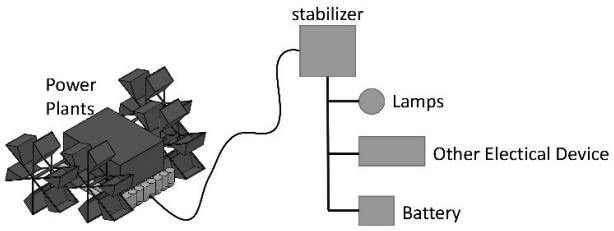

Figure 11. Electrical installation scheme

Figure 11 shows that electrical loads can be lamps, other electronic equipment, and batteries. Before electricity is used for electrical equipment, the stabilizer is used to keep the resulting electricity stable at 220 Volts. Because the electricity standard in Indonesia is the AC-voltage, then the electrical equipment must be AC-voltage.

III. CONCLUSION

This floating portable micro-hydro is still a design. This design is made based on observations of researchers. Next, we have to implement to create a prototype. Then, the prototype will be analyzed and be piloted in the actual environment to know the capacity and efficiency will be produced. Currently, researchers have not been able to determine the capacity of the generator output that to be used. All equipment and materials are readily available throughout Indonesia; only generators still have to be imported from outside Indonesia. The price of the generator will be low if the floating portable micro-hydro is mass produced. We are expected with this design, common Indonesian people who live in rural areas and living close to the river can enjoy cheap electricity and can maintain their power plants by their self.

REFERENCES

1. *Briand, M-H, Ng, K 2010, Kinetic Energy Recovery Turbine Technology: Resource Assessment and Site Development Strategy, World Energy Conference, Montreal, Canada, 13-17 September 2010*
2. *Joseph R, Umanand L. Turbine emulator for development of variable speed microhydro power generation systems. 2012 IEEE Third International Conference on Sustainable Energy Technologies (ICSET). IEEE; 2012 Sep; Available from: http://dx.doi.org/10.1109/icset.2012.6357421*
3. *Kumara, Suparyawan DPD, Ariastina WG, "Sukerayasa W, Giriantari IAD. Microhydro powerplant for rural area in Bali to generate green and sustainable electricity". 2014 International Conference on Smart Green Technology in Electrical and Information Systems (ICSGTEIS). IEEE; 2014 Nov; Available from: http://dx.doi.org/10.1109/icsgteis.2014.7038741*
4. *Robinson P. Microhydro in Papua New Guinea—the experiences of an electrical engineer. Power Engineering Journal. Institution of Engineering and Technology (IET); 1988;2(5):273. Available from: http://dx.doi.org/10.1049/pe:19880051*
5. *Ruopp A, Ruprecht A, Riedelbauch S, Arnaud G, Hamad I. Development of a hydro kinetic river turbine with simulation and operational measurement results in comparison. IOP Conference Series: Earth and Environmental Science. IOP Publishing; 2014 Mar 1;22(6):062002. Available from: http://dx.doi.org/10.1088/1755-1315/22/6/062002*
6. *Wang L, Chen S-J, Jen S-R, Li H-W. "Design and implementation of a prototype underwater turbine generator system for renewable micro hydro power energy". 2012 IEEE Industry Applications Society Annual Meeting. IEEE; 2012 Oct; Available from: http://dx.doi.org/10.1109/ias.2012.6373994*