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CONCEPTUAL PERPETUAL MOTION MACHINE FOR ELECTRIC POWER GENERATION BASED ON 3-STAGE ENERGY INTERACTION NETWORK MODEL

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-- **Abstract** --

Electrical energy and power development from clean renewable sources has been on the front burner of many academic and industrial researches over the past decade ostensibly in view of its criticality in human civilization. An idea to operationalize relevant engineering principles pursuant to the development of a distinct kind of perpetual motion machine (PMM-DK) was conceived; and consequently, a novel compensated 3-stage energy interaction network model for sustainable electric power generation is proposed. Available literature in thermodynamics has ruled off possibilities of realizing functional designs of perpetual motion machines of both the first and second kinds (PMMFK and PMM2) based on perceived contradiction of their design goals with the first and second laws of thermodynamics. In this communication, layout for the design of the conceived perpetual motion machine is presented. Mode of action and interaction for its operational sustainability is expounded. Kick-starting system, speed increasing gearbox, signal step-up transformers, power isolation unit, energy compensating and amplifying systems, monitoring and control modules, and a plethora of other devices (arc condensers, capacitors, et cetera) have been considered for a strategic implementation of a functional layout for the realization of the perpetual motion machine for electric power generation through renewable means with steady re-circulating kinetic matter.---
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KEYWORDS: *Electricity generator, hydraulic power, kinetic matter, perpetual motion machine, renewable energy system*

1. Introduction

In thermodynamics contextual parlance, perpetual motion machines falls into First and Second Kinds. Literally, perpetual motion refers to the action of a device that, once set in motion, would continue its operation infinitely with no additional energy required to maintain it. Such devices are impossible on

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grounds stated by the first and second laws of thermodynamics. Perpetual motion machines of the First and Second Kinds (PMMFK and PMM2) were contemplated by the first and second laws of thermodynamics (Eastop&McConkey, 2002). Desirability of these set of machines were established, but possibility for their construction was dismissed on the basis that their respective operations negates the originating and fundamental laws of thermodynamics.

A perpetual motion machine of the first kind produces work without the input of energy. It thus violates the first law of thermodynamics: the law of conservation of energy. Available literature including that of Nag (2013) reports that operation of the conceptual Perpetual Motion Machine of the First Kind (PMMFK) disagrees with the First Law of thermodynamics as such a machine, when built, would work in a thermodynamic cycle and do no other thing but continuous exertion of work on its surrounding. A perpetual motion machine of the second kind (PMM2) is a machine that spontaneously converts thermal energy into mechanical work while exchanging heat with a single energy reservoir whereas the Kelvin-Plank's statement stipulates that there must be heat rejection (Ansermet& Brechet, 2019; Moran*et al*, 2018). It is instructive to note that while these conceptual devices seem non-realizable, fruitful attempts have been made towards development of functional perpetual motion machines leveraging on various principles of mechanics. Interaction of electro-mechanical systems and electro-chemical energy cells (batteries) have been explored in recent times pursuant to development of *'fuel-less generators'*. It is noteworthy to mention that system dynamics of such fuel-less generators relies on efficient electrical energy delivery to a motor whose motion excites a synchronous generator through which electro-motive force (emf) is generated. Part of the generated emf is utilized in recharging the battery while the remainder goes into utility by domestic electrical appliances. Inverters and ancillary electrical components are often integrated into the circuitry. Perpetual motion machines of engineering significance are highly desirable because of projected capacities of such systems in continuously and continually providing useful energy and power at zero cost of fuelling.

Energy is at the heart of modern society, playing critical roles from human civilization to supporting modern technological developments, such as manufacturing, transportation, food, medicine and communication. Amongst different forms of energy, electricity is the most advanced. Electricity is possibly the most remarkable discovery in the history of human civilization, which has enabled tremendous transformations in the pace of technological developments and human civilization. Today, almost every advanced technological product or device, which constitutes an essential part of modern society, requires electricity to perform its intended function. Therefore, access to electricity has become an indispensable part of modern-life as well as an enabler to accelerate technological advancements and human civilization (Adhikari, 2016).

In the context of the current research, the envisioned perpetual motion machine consists of two rotodynamic fluid power machines *(centrifugal pump and crossflow turbine)* and an electrical power machine *(alternator).* The ultimate goal of the design is to operationalize relevant engineering principles while compensating energy losses with signal step-up transformers in the concerted bid to generate electric power for the sustenance of pump operation and net power output for the operation of other equipment extraneous to the system load (i.e. domestic, industrial, and commercial electrical appliances). In the light of the foregoing, the current engineering inquest is saddled with the burden of graphically developing the envisioned concept for the referenced system. Its practical applicability in real-time power generation for domestic and industrial purposes cannot be overemphasized; hence, comprehensive and systemic design, prototyping, feasibility studies, and experimental determination of its operating characteristics would be a subject of subsequent communication as desirability of such an autonomous hydro-power plant is in pursuance of achieving the Sustainable Development Goal no. 7(SDGs) (2015 – 2030)of affordable and clean energy – a key area of the blueprint cum master plan whose targets and indicators are powerful framework for action to tackle a range of developmental challenges (TETFund NRF Research Brief, 2020).

II. Criticality of the Concept

Desirability of a machine that would work in perpetuity developing and delivering power, at no fuel cost burden and at the same time eco-friendly, cannot be overemphasized. Well-engineered systems

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built for the development of mechanical and electrical power abound, most of which work on specific engineering-based principles and cycles. Nuclear power plants and all forms of internal combustion engines, ordinarily, would pass for perpetual motion machines if not for their dependence on fuels which are bound to be exhausted over a finite time period. Consequently, cost of power produced by these systems has strong correlation with the overall unit costof fuel, which in turn has bearing on the means of production of the fuel. In fact, multiple interactions of factors are involved in this chain which ultimately determines the cost of manufactured products.

Depletability of the fuel sources, negative and hazardous impacts of the fuel-to-energy transformation processes, and a plethora of other reasons gave rise to engineering inquiry on the utilization of renewable energy sources – wind energy, hydro-power, and solar power (Theraja, 2007). These non-conventional power generators have their peculiar drawbacks ranging from high cost of construction *(for classic hydro power plants)* to non-steady, fluctuating or seasonal irradiation and flow of kinetic matter *(for solar, wind, and hydro-powers)* (Okoro*et al*, 2022; Obot *et al*, 2023).
Inquest into cost-effective designs for perpetual power generation from renewable source necessitated in-depth consideration on means of guaranteeing steady, non-fluctuating flow of kinetic mater (high-pressure air or water flow) in a cyclic manner. This gave rise to the current research: a conceptualized self-sustaining hydro-power plant which would operate based on a novel compensated 3-stage energy interaction energy scheme. Its operational self-sustaining attribute and non-dependence on fossil fuel(s) are key indices characterizing the equipment as a perpetual motion machine. Contrary to the working principle of a conventional hydro-electricity generating plant, the conceptualized equipment would utilize kinetic energy of re-circulating water. Working in a cycle with flow recirculation, the closed circuit model plant can perpetually deliver net power from its internally sustainable operation without need for extraneous fuel supply or consumption whatsoever, making it a Perpetual Motion Machine of its own kind.

A. Challenges of other methods of green energy development

The scarcity of energy supply is of great concern in Nigeria despite considerable available energy resources both renewable and non-renewable. The role of energy and power in achieving economic growth needs no emphasis as the state at which it is used has become a veritable indicator of the level of development of a nation. Electricity is one of the major constraints to national growth with the Power and energy sector supplying only 20% to about six million customers; consequently, businesses and individuals run generators several hours per day (Okoro*et al*, 2022).

The twenty first century world is anchored on a highly competitive globalised economy best described as information-rich; knowledge-based; science, engineering, technology, and innovation-driven; and predominantly private sector-led. This calls for integration of science, engineering, technology and innovation-driven, value adding research and development activities into development efforts of the Nigerian nation and the rest of the developing countries of the world (TETFund NRF Research Brief, 2020). Power generation has become a necessity that must be addressed by deploying ingenious hi-tech approaches that favours cheap generation, eco-friendly, and low-noise emission; hence, the current proposed approach which promises to possess design characteristics that does no accommodate peculiar challenges that typically confront other green (clean) energy development systems.

Inquest into green energy development so far reveals that energy beyond fossil fuels holds potentialities for future energy hub (Theraja, 2007). Successful researches on thin-films for photo-voltaic cell applications have been variously carried out, some resulting to development of solar panels that generates electricity from sun light (Hernández-Borja, Vorobiev&Ramírez-Bon, 2011; Oliva*et al,* 2003; Lai-Hung *et al*, 2014; Erich, 2012; Nnabuchi, 2005; Lokhande, 2002; Augustine *et al*, 2017; Dhankhar, Singh & Singh, 2014; Wei, 2007); wind turbines have been designed and installed in suitable areas for harnessing of wind power (Spiegel, 2018; Constellation Energy Corporation, n.d.; Akanksha, 2014); and hydro-power plants and steam turbines for the conversion of pressure heads and strain energy of water into mechanical and ultimately electrical power (Achebe, Okafor&Obika, 2020; Mockmore&Merryfield, 1949; Linquip Team, 2021). In all these endeavours, a common streak that

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runs through their operational cycle is that kinetic matters (unobstructed high intensity sunlight *(consisting of photons or energy particles)*,high velocity wind, high pressure water or steam) are required. With the exception of solar energy systems, the kinetic matter creates a change of momentum as they flow past blades designed to impart rotational mechanical motion to a shaft which drives an alternator. Seasonal, fluctuating, and/or non-steady flow of the kinetic mater has been a major drawback of these classes of power generators, hence, limiting their wide spread despite the inherent ability of these non-conventional sources of energy to be replenished through natural processes. These drawbacks stimulated our interest in the current work, and having devised a means of maneuvering the drawback of unstable (fluctuating) kinetic matter fascinates our determination to implement the conceived autonomous plant model.

I. STRUCTURE OF THE CLASSIC SET-UP

Classic hydroelectricity scheme is conventionally depicted by figure 1, with the turbine section of the plant specifically represented by figure 2. Major drawbacks of these plants include large investments, long gestation period, and increased cost of power transmission (Douglas, Gasiorek &Swaffield, 2002).

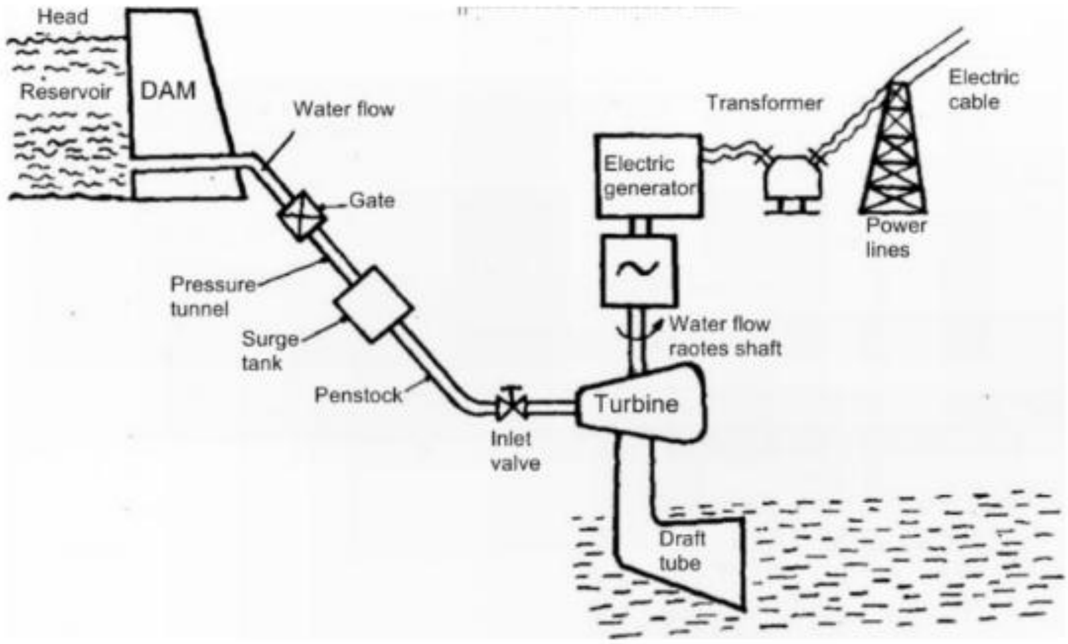

Figure 1: Flow sheet of Hydroelectric Power Plant (Rajput, 2012)

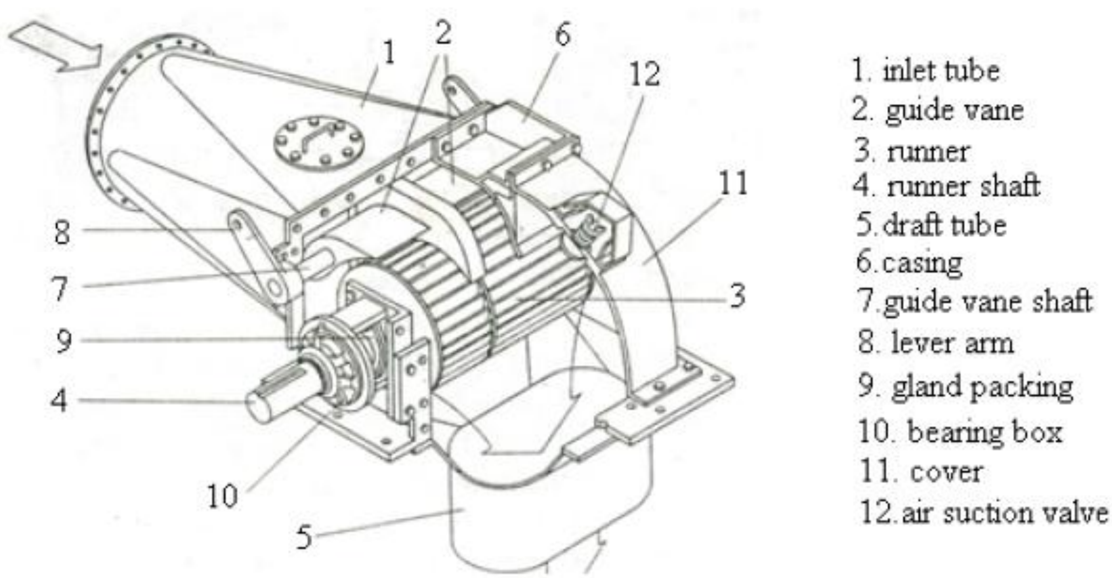

Figure 2: Crossflow Turbine and its major Components (Myin & Nyi, 2018; Yamamoto, 1983)

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The setup demands either a natural or an artificial waterfall with requisite pressure head to achieve high jet impact necessary to create, drive and sustain high rate of change of momentum for the operation (rotation) of the turbine runner. The runner of a crossflow turbine consists of a series of curved blades *(positioned at specific angles)* fixed on two or more parallel disks that are coupled to the shaft for power transmission to an alternator unit. Jet of high-pressure water crisscrosses or cross-flows firstly from outside to inside of the runner, and then from inside to outside of the runner before exiting through the draft tube (Kaniecki&Steller 2003; Adhikari&Wood2018). In this process, the pressure energy is converted into rotary mechanical energy of the turbine runner which drives an alternator via gearbox or belt drive. This theoretical framework which has adumbrated the working principle of a typical hydroelectric plant and components of a classic cross-flow turbine forms the basis of this communication.

IV. LAYOUT OF THE PMM FOR ELECTRIC POWER GENERATION

Figure 3 depicts the schematic configuration of the plant while Figure 4 captures the model layout. Start-up of the plant operation is by cranking via a detachable hand-wheel that initiates turbine rotation. The generator is excited and thus emf generated. Current flow *(I)* operates the rotodynamic pump which delivers high pressure water to the turbine at the flowrate *(Q)*. Blades mounted on disks are positioned so that jet of water from the nozzle impinges on them at an attack angle (α) imparting maximum rate of change of momentum, and hence maximum rotational speed of the runner. Turbine shaft is supported on Conrad bearings that are practically frictionless.

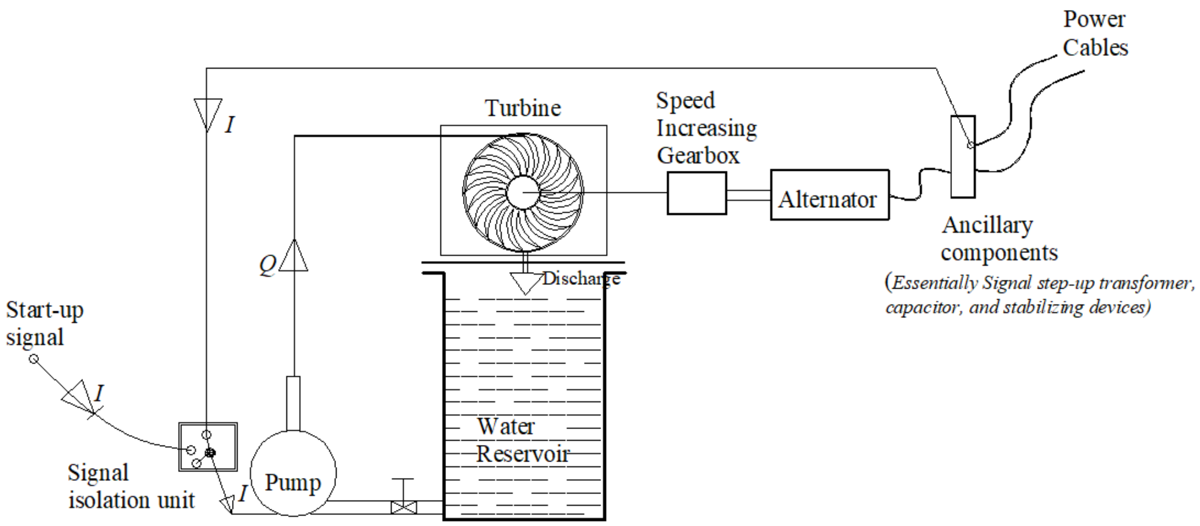

Figure 3: System configuration

Used and discharged water is re-pumped to sustain turbine operation. The design incorporates a speed increasing gearbox with high velocity ratio to insure adequate excitation of the alternator flux field for optimal power output. Ancillary components consisting essentially of signal isolation unit, energy compensating and control devices, and signal step-up transformer are incorporated into the design to enable smooth start-up and running of the system, performance optimization, systemic matching and handling of load fluctuations, varied control functions and output display

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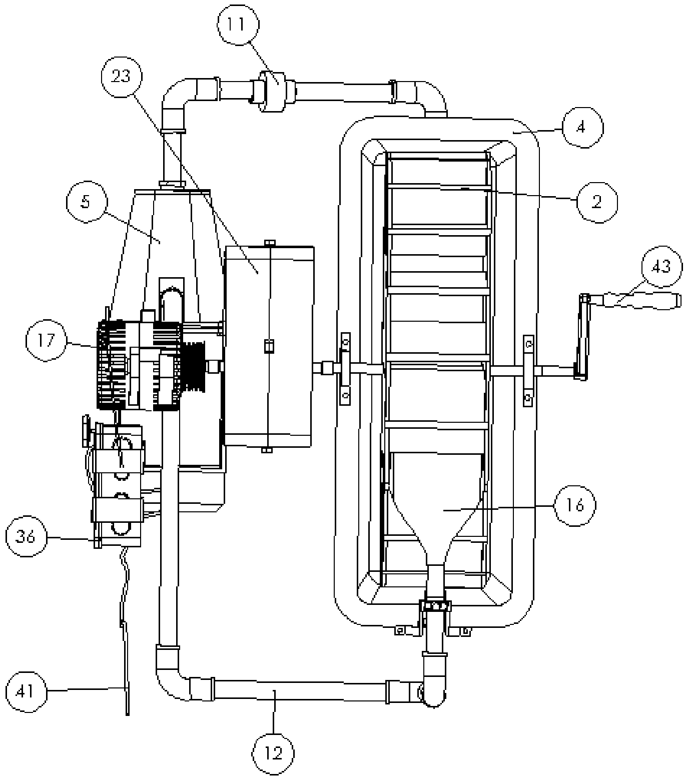

Figure 4: Plant model layout

Table 1:Bill of Materials (BOM)

Part No.	Name of Component
2	Turbine runner
4	Water tank
5	Electric pump
11	Union coupling
12	H/pressure delivery pipe
16	Nozzle
17	Synchronous generator
23	Speed increasing gearbox
36	Control unit
41	Output power line
43	Crank arm

Table 1 captures some of the components of the conceptualized autonomous perpetual motion machine. The electrical and electronics components of the machine control panel are compartmentalized; and interact with the hydro-mechanical system dynamics according to the configuration shown in figure 5.

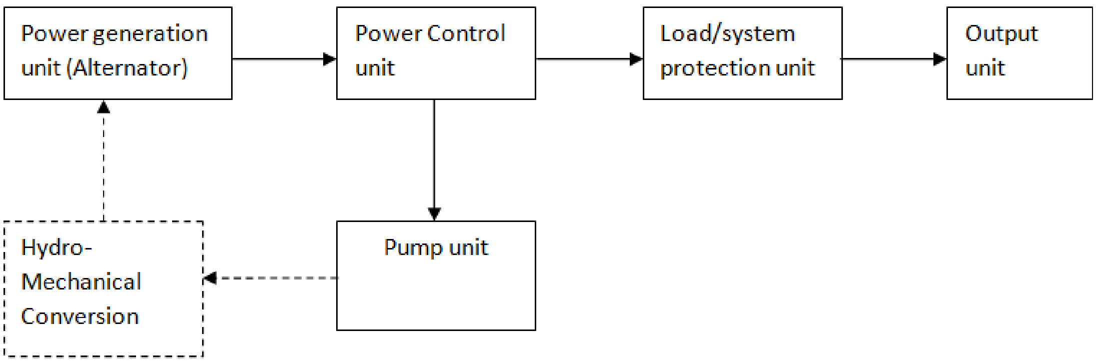

Figure 5: Interaction of Machine Control Module with System dynamics

This schematic layout depicts the interfacing of the various units of the machine operation-sustaining module (power control unit). Signal flow and interaction of various units of the integrated system are represented with arrow lines. Kinematics of motion linkages of the hydro-mechanical system can be perpetually sustained as long as the synchronous generator is excited and emf generated to drive the centrifugal pump's operation. The CAD model of the self-contained hydro-electricity power unit is captured in figure 6.

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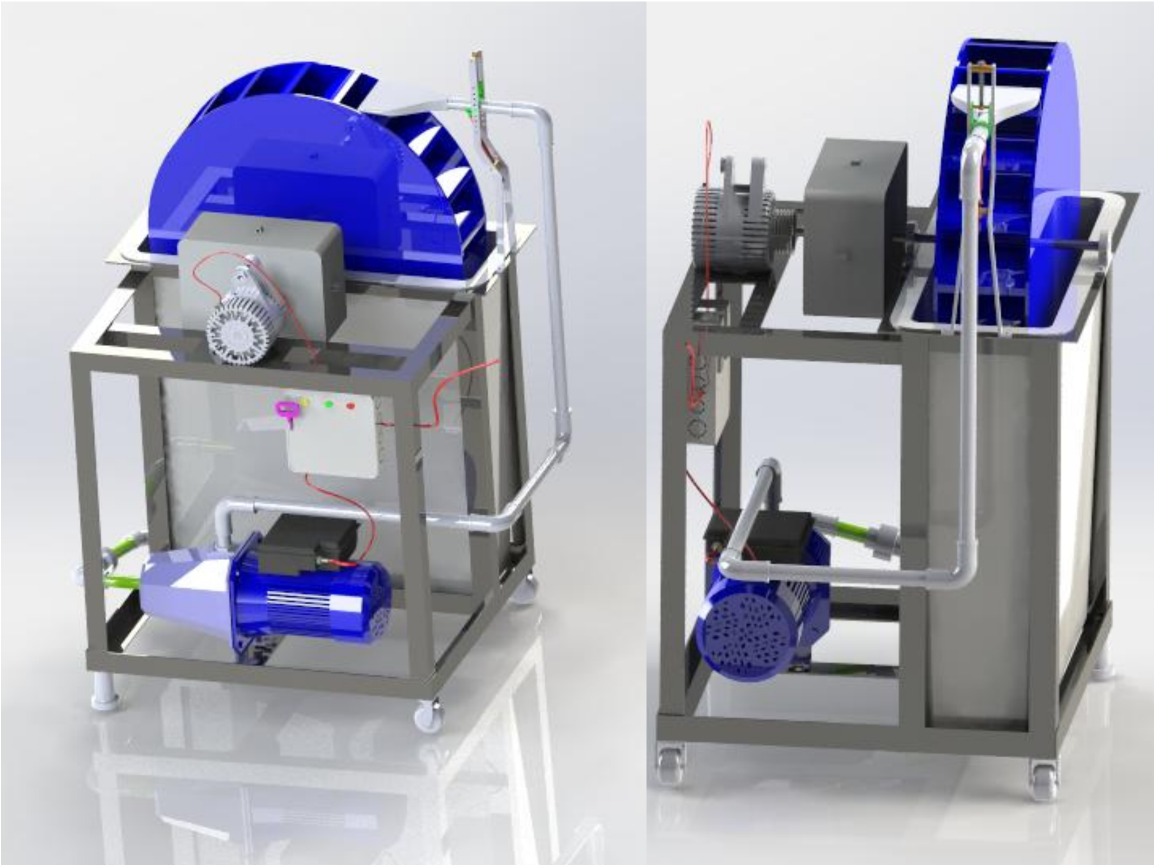

Figure 6: Axonometric views of the designed autonomous hydro-power plant

This design portrays an energy interaction model for the production of net electrical power from a hydro-plant with re-circulating kinetic matter. The concept depicts an autonomous system integrating a centrifugal pump with a crossflow turbine to produce a compact hydro-power plant that works, contrary to classic setup, with finite water volume which is continuously re-circulated by the rotodynamic pump within a closed circuitry. Fluid reservoir, flow discharge, and recirculation systems were designed to insure supply of steady jet through the turbine nozzle.

Imperativeness of Computer-Aided Design (CAD) in the realization of this Conceptual Perpetual Motion Machine (PMM-DK), including its criticality in the overall implementation of the autonomous machine, are expounded by Nwoke *et al* (2018) and Nwoke (2023). Details of the design based on the current concept alongside with the prototype performance characteristics shall be presented in a subsequent communication. The novelty of the work is derived from the fact that the system would neither consume fuels nor rely on naturally fluctuating solar energy, hence, making the autonomous system qualify as a perpetual motion machine distinct from the long contemplated and dismissed PMMFK and PMM2. Put differently, no external energy would be required to drive the generator after the initial cranking.

Implementation of the compensated 3-stage energy interaction network model for sustainable electric power generation has been substantially accomplished as the laboratory results of the prototype being analyzed promises breakthrough for the designed autonomous hydropower plant. The designed plant has demonstrated a conveniently feasible means of miniaturizing and compartmentalizing a classic hydro-power plant for domestic and industrial applications.

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V. CONCLUSION

Sustainable electric power generation is a key driver of modern, industrialized, and technology-based economies of the world. Cheapness *(or otherwise)* of the generated power, to a very large extent determines directly and indirectly prices of manufactured goods, commodities, and services. To this end, the current engineering inquiry has been made towards development of the envisioned renewable energy system. This system promises to have peculiar benefits ranging from clean energy development to economic power generation as it does not run on fuel.

The need to provide steady supply of kinetic matter (high-pressure head water flow) for the crossflow turbine motivated the current study and informed the rational drive to incorporate a centrifugal pump and well-designed re-circulation system that provides for a compact hydro-power plant as opposed to the classic hydro-power systems wherein artificial re-circulation of high-pressure head water jets is non-viable on the accounts of contending economic and technical factors. With the incorporation of start-up system, automatic power isolation module, and signal step-up devices, a scale-model of the conceived perpetual motion machine has been achieved as the equipment can work continuously once started, without consumption of fuel as it were, sustaining its operation and generating net power for the running of external loads. Further studies may consider the incorporation of battery, inverter and charge controller so that energy from the battery could be used to actuate the turbine unit through an electric cranking system.

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Declarations

Author contribution statement

O.N. Nwoke: Conceived and developed the CAD model of the plant; Marshaled out the research protocol; contributed tools/software; Wrote the paper.
I.U. Mbabuike: Surveyed available literature; Wrote the paper.
G.A. Obiukwu: Marshaled out the research protocol; Wrote the paper.
J.B. Otuu: Carried out feasibility study for design implementation; Wrote the paper.
B.O. Nnachi: Contributed materials for prototype development, Wrote the paper.
O.I. Ugboaja: Contributed materials for prototype development, Wrote the paper.
S.O. Eze: Developed the electrical circuit configurations; Designed the control unit; Wrote the paper.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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