International Journal of Innovative Scientific & Engineering Technologies Research 13(4):180-189, Oct,-Dec., 2025

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doi:10.5281/zenodo.17690644

Design, Construction and Performance Evaluation of a Fuel-Less Generator

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ABSTRACT
The need for alternative power sources in Nigeria has become national issue as the power outrage continues to be matter of discussion in the country, This led to a number of alternatives, some of which have been environmental pollutants (such as fuelled generators) other are unaffordable and unavailable due to huge cost and scarcity. In response to this, fuelless generator was designed and developed using readily available and costless materials. The driving mechanism of fuelless generator is the 1hp direct current motor, powered by a battery, which spines a car alternator to produce electricity, while recharging the battery by means of a diode. The fuelless generator has an efficiency of 90.9% when loaded with 100 W bulb; it is pollution-free and eco-friendly. The test unit was built in November, 2025 and has been tested by increasing the power load of 100 W at time interval of 8 hours, with a total power load of 1000 W within the time frame of 72 hours no disrupted power.
Keywords: Fuelless generator, Diode, Alternator, direct current, efficiency, Rectifier.

INTRODUCTION

The global consumption of energy is growing and there is need for more renewable energy sources that will be free from carbon monoxide which causes environmental pollution that leads to degradation of Ozone layer (Ajayi, 2012). In order to find other ways of producing environmental friendly energy, a number of alternatives has arises from non-conventional energy sources that are renewable in nature; one of these alternatives is the generation of power from fuel less engines (Adewumi, 2015).

Power generation and distribution has been an indispensable factor in the progress of an economy, ranging from manufacturing, banking, media, healthcare, aviation, education etc (Atere, 2009). Since power has been defined by Knight (2004) as the rate of doing work; this simply means that the productivity of a country will largely depend on the availability of power from different source. Thus, Adegoke *et, al.,* (2021) states that majority of the problems of Nigeria is traceable to the erratic power supply nature of the country, where many activities has been paralyzed due to the power outage. Analysis has clearly showed that Nigeria lose up to about N220 Billion annually, due to the unstable nature of the

country power supply which has poses a threat, hence reducing the capacity of industries to increase productivity (James,2005). Lack of routine maintenance in the generation, transmission and distribution of electrical networks and systems had caused significant deterioration in plant output, thus contributing to the lingering electric power crisis in Nigeria (Ajav and Adewumi 2014). Consequently, industrial and residential consumers of energy resulted in using standby generating plants thus making the country the largest buyer of internal combustion engines globally (Okediyi, 2010). In finding alternative means of producing energy, the transition to non-conventional and renewable energy sources is on the increase daily. One of these alternatives is the fuel less generator which generates electricity without the use of fossil fuel such as petrol, diesel, oil, or coal (Adegoke *et, al.,* 2021).

The aim of the work is to create a generator, capable of producing electricity without using any fuel.

Concept of Fuel less Generator

A fuel less generator refers to a system that generates electricity without consuming conventional fuels like gasoline, diesel, or coal. i.e a generator set that produces electricity without utilization of any fuel. The generator consists of the following component or sub system: voltage source (Battery) to drive a Dc motor coupled with an alternator, the A.C generator (alternator) driven by the motor produce A.C output, at the output terminal a battery charger circuit is connected to continuously charge the input battery. These make it possible for the generator to answer the title fuel-less generator.

Components of Fuel less Generator

The fuel-less generator setup consists of the following main components:

- 12V DC Motor (drives the alternator)
- Car Alternator (converts mechanical energy into electrical energy)
- Battery (12V, Deep Cycle) (stores power for motor and output)
- Rectifier & Voltage Regulator (converts alternator's AC output to DC)
- Inverter (12V to 220V AC) (converts DC to usable AC power)
- Control Circuit (manages power distribution)

Working Principle of a Fuelless Generator

The construction of a fuel-less generator is based on the principles of electromagnetic induction, as described by Faraday's Law of Induction. According to Faraday's Law, a changing magnetic field induces an electric current in a conductor. In this system:

Electromagnetic induction

Electromagnetic induction is the process by which a changing magnetic field induces an electric current in a conductor. This phenomenon was first discovered by Michael Faraday in 1831 and later formulated mathematically by James Clerk Maxwell as part of Maxwell's equations. Electromagnetic induction is the fundamental principle behind electric generators, transformers, and many other electrical devices.

Faraday's Laws of Electromagnetic Induction

First Law (Induction of EMF)

The law states that: A changing magnetic field in a closed conducting loop induces an electromotive force (EMF) and, if the circuit is closed, an electric current.

Experimentally, when a magnet is moved towards or away from a coil, an induced current is observed in the circuit.

Second Law (Magnitude of Induced EMF)

The law states that: The magnitude of the induced EMF is directly proportional to the rate of change of magnetic flux linkage.

Lenz's Law states that

The law states that: The direction of the induced EMF and current in a circuit is such that it opposes the change in magnetic flux that caused it.

Note:

- If the magnetic field increases, the induced current generates a magnetic field in the opposite direction to reduce the change.
- If the magnetic field decreases, the induced current creates a magnetic field in the same direction

to oppose the reduction.

- This is a direct consequence of the law of conservation of energy, ensuring that no energy is created from nothing.

Many studies have explored the use of permanent magnets and coils to create self-sustaining energy loops. These systems work on electromagnetic induction. Below are some of these researches

Oluwaseun, *et, al.,* (2019) designed and Evaluated a self-starting fuel-less power generator using a DC motor as the prime mover to generate electrical energy from an alternator. The results revealed that the generator was able to power variable loads ranging from 0 to 2000W, with the efficiency decreasing as the load increased, indicating the need for further optimization.

Oluwasogo, *et. al.,* (2020). Developed a Self-Induced Fuel-Less Generating Set with a focus on a self-sustaining generator where a 12V, 100Ah battery powers a DC motor, which drives an alternator. Part of the alternator's output is used to recharge the battery, aiming for continuous operation without external fuel sources. The generator operated successfully under various load conditions, but maintaining battery charge balance was critical for continuous operation.

Abonyi, *t, al.,* (2021). Developed a system where a 12V DC motor, powered by a rechargeable battery, drives an alternator. The alternator's AC output is then converted to DC to recharge the battery, and also interfaced with an inverter to supply AC loads. The system was able to power loads up to 2 kW, but efficiency decreased with increasing load, indicating the need for better energy management strategies.

Sukchai, *et. al.,* (2021). Developed an Advanced Electric Battery Power Storage for Motors through the Use of Alternators to test the working principle of a 12V DC motor connected to an alternator, aiming to generate electric power and store it efficiently. The result shows that the system demonstrated the feasibility of using alternators in conjunction with DC motors for power generation, highlighting potential applications in renewable energy systems.

Azeez, *et, al.,* (2018) Design and Constructed a Fuel-less generator, the study involved designing a generator where a 12V battery powers a DC motor, which in turn drives an alternator to produce electricity. The system includes a diode to recharge the battery, aiming for continuous operation without traditional fuel sources. The generator successfully produced electricity; however, challenges related to efficiency and sustainability were noted, emphasizing the need for further optimization.

Otulana *et al.,* 2015 used a locally sourced material to develop a 1 kVA fuel less generator with a driving mechanism of 1hp DC motor to spines a 0.95 kW alternator. The DC motor was powered by a 12 V rechargeable battery which recharges through a rectifying diode.

Dipali *et, al.,* (2017) worked on a simple and efficient means of generating electricity with readily and easily available materials. The authors revealed that the system can be built to any capacity depending on the load requirement, and the system does not require frequent mechanical maintenance.

A 2.5 kVA self-induced fuel less generator was constructed by Adewumi (2016) using a self-induced engine as an alternative to isolated power generation from renewable energy sources because of its low cost of purchase and maintenance, as well as the reliability. The component used for the construction includes DC motor, 12V 100Ah battery, AVR panel, and charging panel. The performance evaluation was performed using loads ranging between 0 W and 2 kW for 300 seconds. The outcome of the research shows that the self-induced power generating set must make use of a new direct current motor and alternator for future study for reliability and better performance of the system.

Summary of the performance evaluation of some research reviewed in presented in the table 1.0

Table 2.1: Efficiency performance of some fuelles generators

No.	Author (year)	Reported Efficiency (peak / average)	Key features / notes
1	Adewumi & Adelekan (2016)	Peak: 97.4% (100 W); Avg: ~56.4% at 600 W	DC motor + alternator + inverter; efficiency drops with load.
2	Samuel (2018)	Peak: 89.1% (100 W); Avg: 56.4% at 600 W	1 kVA motor-alternator; battery assist; typical lab prototype.
3	Oyinkanola *et al*. (2024)	Peak: ~91% (100 W); Low: 20–28% (1.6 kW)	Recycled parts; charging circuit variations significantly affect performance.
4	Morka & Okpala (2020)	Peak: 94.8% (100 W); Very low at very high load	Hybrid flywheel + alternator + motor; high peak but poor scaling at large loads.
5	Omo-Oghogho & Ofomaja (2025)	~81% (system test)	Flywheel-assisted design; sustained good performance in bench tests.
6	Adegoke *et al*. (2019)	Peak high at low load (~97%); declines with load	2 kVA prototype; efficiency strongly load-dependent.
7	Aliemeke (2024)	High bench efficiency reported (varies by load)	1 kVA battery-driven alternator; detailed load curves in original study.

MATERIALS AND METHODS

Materials:

The materials needed for the research are

- ✓ Direct Current Motor :one horse power dc motor
- ✓ Battery: 12 volts battery, to rotate the motor.
- ✓ Alternator: to generates an alternating voltage and current with the aid of capacitor.
- ✓ Diode: For constant recharging of the battery.
- ✓ Capacitor**:** to aids the conversion of energy from the alternator in to an alternating voltage.
- ✓ Ignition key**:** This is used as an ON and OFF control of the generator system.
- ✓ Shaft**:** The shaft is used to transmit toque from DC motor to the alternator.
- ✓ Cables**:** Cables are used to transfer current from one source to a load
- ✓ Multi-meter and other measuring devices
- ✓ Circuit board and loads

METHODOLOGY

The generator was constructed using a direct coupling method. The construction of this generator set was carried out in two phases; the design (construction and coupling) phase and casing (housing the coupled system) phase.

Design Phase

The design phase of the fuel-less generating set, consist of the following steps

Step 1: Fabricating a crankshaft and boring a reasonable hole that will conveniently fit in to the DC motor with thread hole for bolting the motor to the crankshaft.

Step2: Fitting the fabricated crank shaft into the DC motor

Step 3: Inserting the DC motor with crank shaft into the crank casing of the alternator.

Step4: Fitting the armature of the alternator into the casing.

Step5: Dropping the stator core of the alternator into the armature

Step 6: Inserting a long bolt through the bearing end of the stator and tighten firmly to connect the motor and the alternator together.

Step 7: Replacing the cover of the alternator and fasten both the cover and the crankcase together.

Step9: Connecting the diode to green cables and capacitor to the yellow ones.

Step 10: Connecting the terminals of the DC motor to equivalent terminals of the battery

Step11: connecting the red cables to the mains as output.

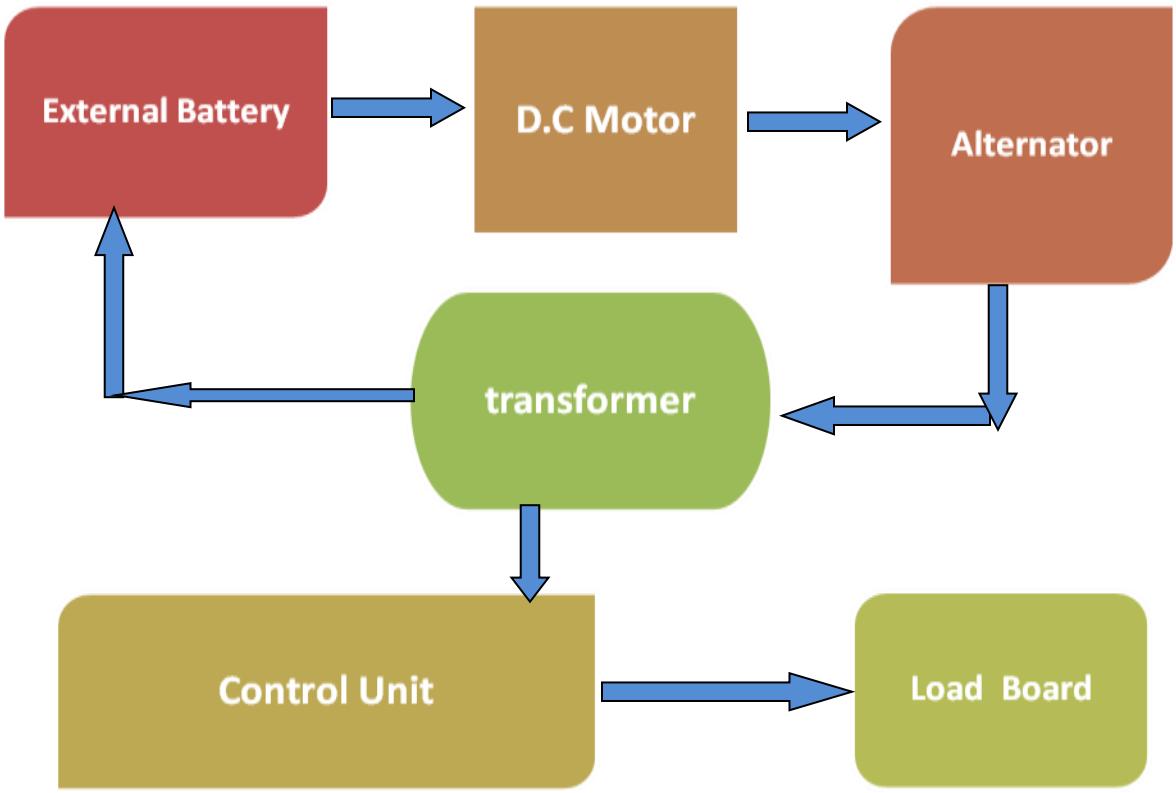

Figure 1: Block diagram of the fuel less generator

Casing Phase:

This part provides support to all components of the fuel-less generator. It serves as housing for all component parts of the machine. A piece of angle iron 40mm x 40mm x 5mm was measured and cut to sizes and weld together to make a stand of length 61mm, width 40mm and height 19mm; brazed at different points for regularity with angle bar of 1.5mm x 1.5mm

***Motor And Alternator Base*:** A piece of angle iron of dimension mentioned for the frame is cut into length 21mm x 10mm and weld to the main frame to serve as the motor base

Similarly, a piece of angle iron dimension (1.5mm x1.5mm) cut into length 20.5mm x 12mm and weld to the frame form the base for the alternator.

The plate of length of 60mm x 19mm was cut into and weld to the frame to make up with the seat of battery and the self-charging panel of the generating set. A permanent magnet alternator is a power generating device that produces a sinusoidal output when a mechanical input to its hub or shaft is applied.

Determination of Parameters

Current Produced in the Armature Coil

The current produced in the armature coil of the developed generator was determined by Equation (1)

$$P_a = I_a V \quad (1)$$

Where V = voltage of the battery (220Volts),

I_a=Armature coil current, and

P_a= Apparent power in KVA

The Power Input to the Coil

The power input to the coil was determined by applying Equation (2)

$$P_i = IVCos\theta \quad (2)$$

Where

P_i = power input to the coil,

Cosθ = Power factor taken to be 0.85

The Electro-Mechanical Power from the Direct Current Coil

The Electro-Mechanical power developed by the direct current coil was determined by Equation (5)

$$P_m = E_b \times I_a \quad (5)$$

Where P_m= Electro-mechanical power from the direct current coil, and I_a= current through coil.

The Electrical Power

The armature voltage consists of the sum of potential difference between the armature and the back E.M.F.

The electrical power is the product of armature voltage and the current. This is as given in Equation (7)

$$P_E = (I_a^2) \times R + E_b \times I_a \quad (7)$$

Where P_E= Electrical power developed.

The Battery Power

The power capacity of the generator battery was determined using Equation (8)

$$P_B = V_a \times I \times Cos\phi \quad (8)$$

Where

P_B = Power capacity of the battery,

V_a= Voltage drop across the armature.

RESULTS AND DISCUSSION

Results

Performance evaluation of the designed generator was carried out to determine if the system satisfied the designed specification, the testing was conducted by using bulb lights, a multimeter was used to measure current and voltage produced during the test, the testing was conducted by increasing the load at different time interval, the readings were obtained three times for accuracy, and the mean values were computed. The output efficiency of the system was computed using the output data obtained during the testing process with varied load capacities as presented in Table 4.1. The load capacity used for testing ranges from 0 W to 1000 W. The experiment revealed that when the load capacity increases, the efficiency of the system decreases. The generator shows an efficiency of 90. 9 % when the load was increased from 0 to 100 W, then the efficiency started to decrease thereafter as the load was increased, the lowest values of 31.3 % was recorded when the load of 1000 W capacity was applied.

Table 4.1: Output Efficiency for the Fuelless Generator

Test	Load (W)	Input Voltage (D.C) (v)	Output Voltage (A.C) (v)	Input Current (A)	Output Current (A)	Input Power (W)	Output Power (W)	Efficiency (%)
1	0	0	0	0	0	0	0	0
2	100	22.45	228	5.14	0.46	115.393	104.88	90.9
3	200	22.50	207	6.02	0.49	135.450	101.43	74.9
4	300	22.59	192.82	6.82	0.54	154.064	104.12	67.6
5	400	22.62	175.24	7.35	0.59	166.257	103.39	62.2
6	500	22.70	150	7.83	0.69	177.741	103.50	58.2
7	600	22.63	138.02	8.07	0.75	182.624	103.52	56.7
8	700	22.57	120	7.24	0.67	163.407	80.4.	49.2
9	800	22.49	109	6.65	0.53	149.559	57.77	38.6
10	900	22.40	95	5.08	0.45	113.792	42.75	37.6
11	1000	22.35	78.01	4.35	0.39	97.225	30.42	31.3

DISCUSSION

A review of recent experimental studies on fuelless generator prototypes shows a wide range of reported efficiencies. Many studies report very high peak efficiencies (≈89–98%) at light loads (~100W), but average efficiencies measured under continuous higher loads frequently fall to ≈40–60% (e.g.,Adewumi & Adelekan 2016;). A smaller group of prototypes demonstrates sustained efficiencies in the 80–87% range in bench tests (for example, Omo-Oghogho & Ofomaja 2025;), suggesting that good design of coupling, energy-assist systems, and low-loss power electronics can maintain high average performance.

The average efficiency of 90.9% achieved in the present work therefore compares favorably with the literature: it is considerably higher than the typical average reported for continuous operation at higher loads (≈40–60%), and falls within the upper performance bracket alongside the better performing prototypes (≈89–98%). The result indicates effective loss minimization in the present design (e.g., coupling selection, power electronics and storage/assist strategy) and justifies further scale-up and durability testing under broader load profiles.

CONCLUSION AND RECOMMENDATION

Conclusion

The design, construction, and performance evaluation of the fuelless generator undertaken in this study demonstrate its potential as a viable and sustainable energy solution, offering a promising alternative to traditional energy sources. The comprehensive efficiency testing conducted reveals a notable capacity for energy conversion, underscoring the generator's ability to harness and convert energy effectively. The findings of this research contribute significantly to the advancement of innovative and environmentally conscious energy generation technologies, providing a valuable foundation for future developments in this field.

Recommendations

It is recommended that future research focus on optimizing the generator design to enhance efficiency and power output should be conducted; other alternative energy sources for integration should be explored for developing energy storage systems to stabilize energy output. Additionally, a comprehensive cost analysis should be conducted to determine economic viability and commercialization potential of the technology. An environmental impact assessment is also necessary to evaluate the generator's eco-friendliness and sustainability.

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