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The Conceptual Design of An Electro-Magnetic Power Generator

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Abstract
Nowadays, magnetic field induction is a dependable renewable energy source that can convert magnetic fields into electrical power. In this study, our objective is to propose a low-cost free energy generator design based on neodymium. The main problems with existing generators were air pollution, noise pollution, and even fuel price volatility. To begin addressing this issue, we compared 6 currently used generators. We concentrated on 5 criteria in light of this outcome. Our top considerations in this study are cost and maintenance. Then comes the size, weight, and noise. The best electromagnetic power generators for satisfying all the criterion domains are determined using Pugh's matrix. It demonstrates that electromagnetic power generators have a high score of 95 compared to natural gas, portable, and diesel power generators. We have also calculated the resulting voltage from the selected number of permanent magnet coils. This calculation shows 60V resulting in 9600 turns. As a result, we draw the conclusion that the reduction of problems like noise and air pollution makes this power generator look like a very appealing alternative.

INTRODUCTION

Over the past few decades, energy and the environment have been major global challenges. Creating alternative energy sources to respond to the world's finite energy supplies is one of the biggest issues in science and technology. As a result, research into renewable energy sources is receiving more and more attention from scientists and engineers. According to Abdullah et al., (2019), Malaysia is increasing its reliance on renewable energy sources like wind, biomass, solar electricity, and hydropower.

Renewable energy may be a more long-lasting alternative than present energy sources, according to M. Irfan (2020), because it is produced from existing resources and managed responsibly. Compared to renewable energy sources, which are also more cost-effective, fossil fuels negatively impact the environment. Renewable energy sources can completely satisfy human civilization's energy requirements.

Conventional sources of electricity, like generators, rely on fossil fuels, alternative power sources like nuclear power, or electricity obtained in any other way as its energy source. Therefore, a simple power source is required to maintain, largely pollution-free to run, and needs little outside power. Therefore, using renewable energy is necessary for producing electricity. Both static and rotational modes of operation are available for the generator. Ahmad (2017) claims that solar and fuel cells use static power electronic converters to produce electricity. Micro, hydro, and wind turbines were all equipped with rotating generators in between.

Alternative energy has been considered a viable option to provide a reliable and affordable electricity supply because of its financial benefits, economic feasibility, and environmental friendliness. Research is now being done on the perpetual motion machine (PMM), a concept that utilises energy (Hidayat, Chairandy, & Ronilaya, 2021). Since electrical power is only created by the repelling forces of two or more permanent magnets, the only time energy is truly free is when we stop paying for its generation (Abdalla, Elmaleeh, & Mahmoud, 2020). Electromagnets are utilized to produce this power based on Faraday's electromagnetic induction law.

Shahl (2015) claims that the only limitation limiting the strength of magnetic energy is the number of intermolecular forces trapped within the material, making it.

The essential premise of energy production is the magnetic effect. According to this claim, a conductor's rotation in a magnetic field causes a voltage to build up inside of it. A simple device with magnetic repulsion as its energy source was created by John Bedini in the early 1900s (Ninlawat, 2019). There are certain advantages to employing magnetic repulsion to generate electrical energy, aside from the fact that magnets are not affected by external conditions and their use is environmentally acceptable. Many academics have since continued to research this Bedini idea in further depth (Hidayat et al, 2019). This free energy concept has proven to have the ability to improve rotating machinery's backup storage power management technique (Ratthasak, 2017).

Neodymium is one of the magnets that the majority of scientists employ in their studies. Hidayat (2021), Muszaffarsham & Osman, (2021), and others claim that the magnet has the greatest magnetic field, the highest thermal stress, and the longest lifespan. In the study by Soemphol & Angkawisittpana (2020), high-strength 12-pole neodymium magnets are used to generate the external magnetic fields in a stator. This permanent magnet generator was said to be made of neodymium since it is very easy to find and produces stronger magnets with less volume than other magnets.

In order to address the three main issues of air pollution, noise, and fuel consumption, our research aims to suggest a new generator that is more portable, lightweight, manageable, and small. Additionally, various design and parameter considerations based on past studies have been made when designing magnetic energy generators. We also go over the findings of a calculation done to determine the voltage generated based on the number of permanent magnet coils chosen for this design.

MATERIALS AND METHODS

The design process flowchart is shown as a starting point in Figure 1. This flowchart is a tool for showing a variety of job progress indicators. Knowing which steps unnecessary and which developments need to be improved makes it easier to understand the process. Flowcharts can be used to analyze issues more effectively. It facilitates decision-making by outlining exactly what actions each stage of the process calls for.

Think about the design and functioning first. We also take the new power generator's size, weight, and upkeep expenses into account. This electromagnetic power generator is driven by neodymium magnets. The construction of the electromagnetic generator should then follow the laws in force at the time. In this design project, the Electricity Regulations of 1994 were studied and taken into consideration under Regulations 15 (Apparatus, conductors, accessories, etc.), 17 (Generators, motors, transformers, etc.), and 24 (Portable apparatus in general).

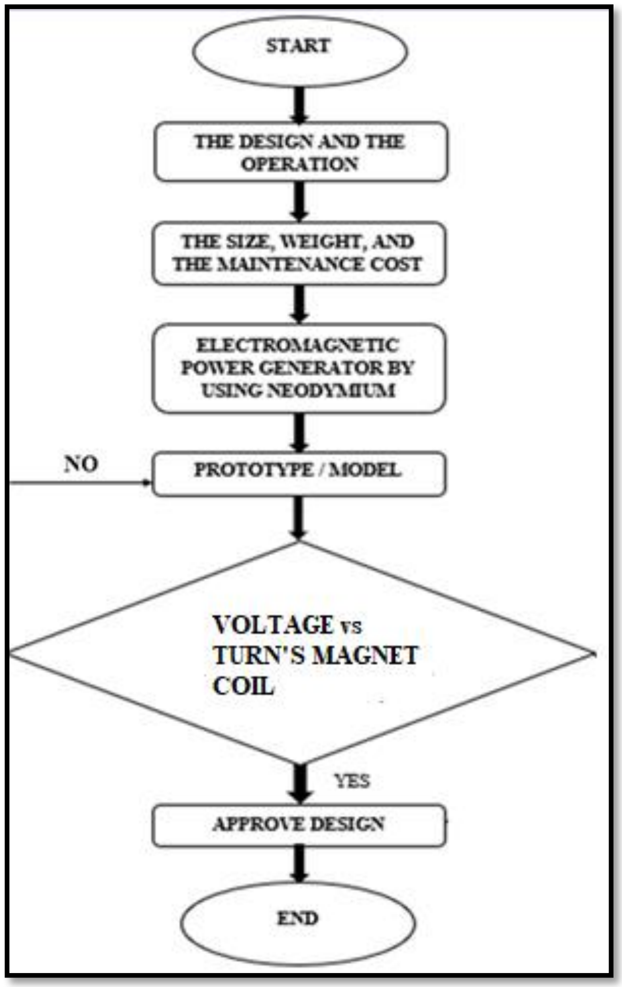

Figure 1. Design Process Flowchart

Before developing the design concept for this study, it is necessary to thoroughly investigate the specifics of the existing design research by weighing its benefits and drawbacks. When camping, a generator is typically used to keep your phone charged or to keep your house's lights on during a power outage. Generators provide a source of electricity when you are not connected to the grid by transforming mechanical energy into electrical energy.

Table 1 shows that, on many people's priority lists, environmental concerns are increasingly taking the place of the need for energy. This will increase the importance of environmentally friendly electricity generation. The electromagnetic power generator, a revolutionary power generation idea, is expected to become more advantageous and ease concerns in the future.

Table 1. Comparative Analysis of Current Generators

No	Type of Generator	Advantages	Disadvantages
1	Natural Gas	• Emissions are minimal. • Unpolluted fuel • Connectable to the current pipeline	• Maintenance costs are high. • Cannot be used indoors. • Higher installation costs
2	Portable	• Can run a variety of smaller tools and appliances. • Is portable and lightweight. • Can be stored. • Is less expensive than all other generator types.	• Noisy • lacking in power compared to a whole-house generator. • unable to run all tools or appliances. • slow to start in an emergency. • Use outside, at least 20 feet away from your house.
3	Inverter	• It is typically the quietest generator, • emits fewest emissions, • the best generator for electronics, • is portable, and • requires little maintenance.	• Costlier than portable generators • A smaller power outlet
4	Gasoline	• Usually, the most affordable generators • Gas is inexpensive, • The simplest form of the generator to locate, and • Quieter than diesel generators.	• Gas is more expensive than other fuels, • has more pollutants, • is very combustible, and • can only be used outside.
5	Diesel	• Has a longer lifespan than gasoline. • Runs more cost-effectively than gasoline.	• Noisy • Only used outdoors. • Expensive compared to gasoline generators. • Harmful emissions
6	Solar	• Low upkeep. • No emissions. • Operable inside	• Low power output, • potential reliability issues, and, • cost

According to the American Bureau of Shipping [ABS] (2022), the product reliability goals are distinct from safety or design standard performance goals as the foundation of a reliability process. The goals of safety performance are to eliminate hazards to lives, physical assets, or the environment. Meeting specified engineering design standards for structures, parts, and product functional criteria is the emphasis of design standard performance goals. While safety or design standards may be related to reliability goals, reliability goals focus on expected product functionality and performance over its lifetime.

Simply said, safety is a state or situation in which you are at no risk and not in danger. While reducing workplace accidents and injuries, safety regulations enforcement can boost productivity. A person can avoid accidentally engaging in risky behavior by taking safety precautions. Therefore, in order to use this electromagnetic power generator securely, people must be aware of the advice given in Table 2.

Table 2. Reliability of the product and safety

Safety Precaution	Description
Recognize safety manuals	• Make certain that only people who have read the product safety instructions operate the electromagnetic power generator. Also, pay attention to any cautionary statements in user guides and on unit labels.
Secure the electromagnetic power generator if departing unattended	• Never leave it unattended anywhere other than a flat surface where there is no possibility of it rolling, toppling, or sliding. • Placing it away from heavily trafficked areas to avoid unintentional bumps that could cause the power generator to topple or roll.
Watch out for dampness	• When using a generator next to standing water, proceed with extreme caution. Anyone nearby is at risk of receiving a shock if the electricity in this standing water is exposed.
Keep the area around the generator and clean	• Keep the generator and the surrounding area clean of debris for the safest working environment. • Take out any rags or anything that can pose a fire risk. • Refrain from operating near or in standing water.

The essential requirements and constraints will have an impact on the project design. The provided criteria will be able to supply the limits to complete the design process. We used the Pugh Matrix in this criteria selection to identify the best option among the 4 different generator types (Kutay & Petrisor , 2021).

RESULTS AND DISCUSSION

The Pugh Matrix, a criteria-based decision matrix, uses a scoring system to decide which option, out of numerous that could be examined, should be chosen. Use a scale of 1 to 5 to rank the criteria. From 1 to 5, with 5 being the most important, is the significance scale. Based on the established criteria, Table 3 illustrates the analysis to support the conclusion that the Electro-Magnetic Power Generator is the best option.

Table 3. Matrix for Pugh Selection

Criteria	Weighing	Options			
		Diesel Generator	Portable Generator	Natural Gas Generator	Electromagnetic Power Generator
Noise	3	1	3	2	5
Size	3	2	3	3	5
Cost	5	2	4	3	5
Weight	4	3	3	2	5
Maintenance	5	2	3	3	4
Total Score		41	65	53	**95**

Given that our electromagnetic power generator received the best overall rating, it is obvious that it has the best chance of being the best alternative in terms of noise, size, cost, weight, and maintenance.

A frequent cause of material selection problems is failing to select the appropriate material for a particular application. Aamir et al (2020) asserts that this technique is crucial to the design and manufacturing processes. The overall goal of material selection is to minimize costs while still achieving performance goals and client needs. For this electromagnetic power generator, we used a range of parts, as shown in Table 4.

Table 4. Cost of materials.

No	Material	Quantity	Price Per Unit (RM)	Price (RM)
1	BLDC motor	1	247	247
2	Stainless steel rod	1	25	25
3	Plastic roller	1	20	20
4	Neodymium N48 magnet bar	8	17.20	137.60
5	Iron plate	2	46.50	93
6	Copper wire	2	19	38
7	CBB61 capacitor	1	5	5
8	Plastic holder	2	2	4
9	Step down transformer	1	390	390
10	Metal case	1	65	65
			TOTAL	**1024.6**

Ching & Chang, (2022) determines the quantity of turns for a single-phase generator with coils that is oriented at a normal angle using references to Cheng, (2011); Ishak (2004) as follows:

In this study, we decide to use a wire that is copper-clad aluminum and has the following characteristics:

$Diameter$, d = 0.04cm

$Density$, ρ = 3.3g/cm^3

Mass, m = 250g

so, Length of cooper, $L = (m / 2\pi r^2 L)\ \rho$ (1)

$= 301.43m$

Next, we calculate how many revolutions are necessary to equal 301.43 meters in length.

The circumference of each coil, $S = \pi \times d$ (2)

$= 0.0314m$

The number of turns. $N = L/S$ (3)

$= 9599.7$

$\approx 9600\ turns$

In their estimation computation to determine the maximum power generation, Ching, (2022) quoted Saha, (2006).

The maximum Voltage generation estimate calculation, $\varepsilon_o = 2\pi NBAf$ (4)

which,

$B = magnetic\ flux\ of\ N48\ Neodymium$ magnet

$A = contact\ surface\ are$a

$f = frequency$

Then, finally the maximum voltage generation for 1 coil = 30.159 V

In this study, we use 2 coils, so the total voltage generated is $\varepsilon_T = 2\varepsilon_o = 60.318$ V

These calculations demonstrate that this generator is suitable for a variety of uses. The voltage that results also depends on the total number of magnet spins. It functions flawlessly as a battery or voltage regulator at this voltage. Our plan to create an electromagnetic power generator is depicted in Figure 2. Additionally, we made the safety housing more aesthetically pleasing to make utilizing this generator easier for users.

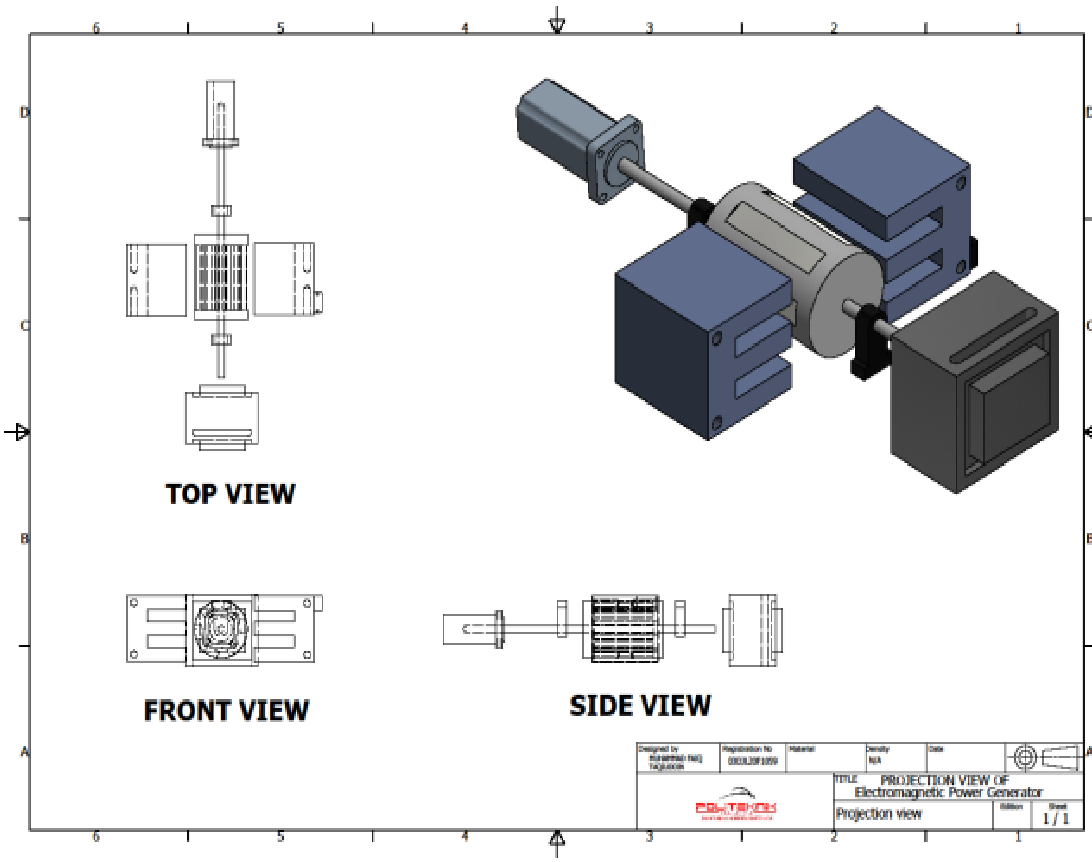

Figure 2. Design of an electromagnetic power generator.

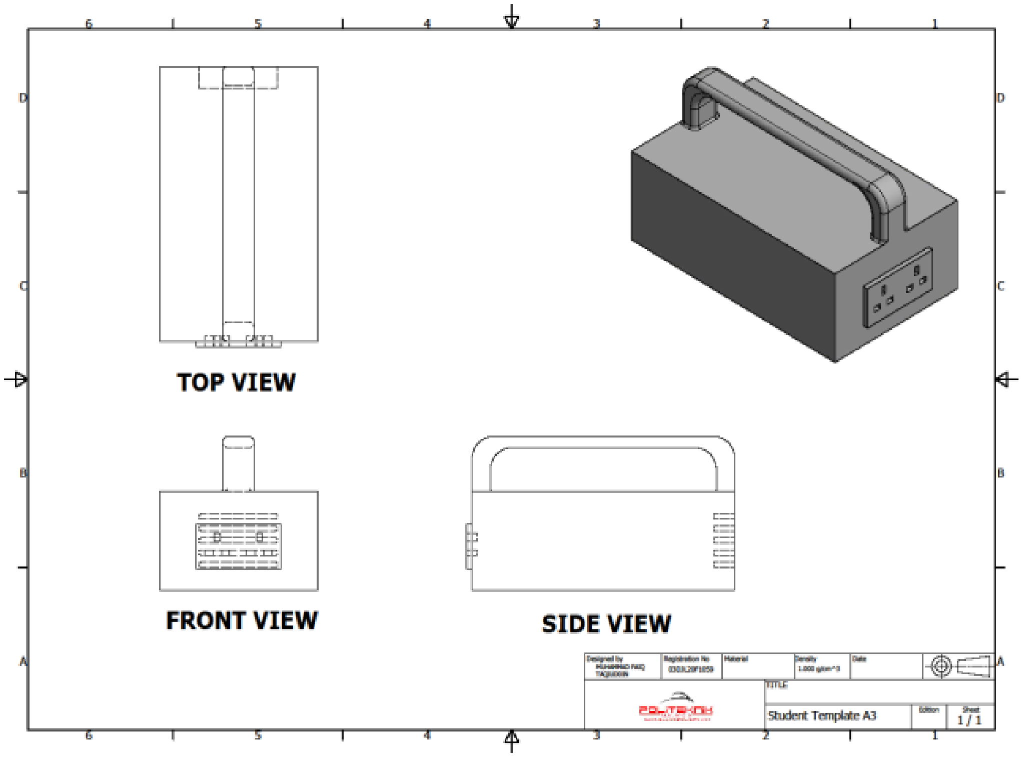

Figure 3. The Electromagnetic Power Generator's metal housing.

As a result, the proposed design makes it simpler for people to access an electricity source. In order to address current problems, such as noise pollution, air pollution, and others, which is a crucial demand owing to economic development, an electromagnetic power generator looks to be a highly alluring option.

CONCLUSION

Current power generators are known to be obtrusive, heavy, and expensive to operate. It might lead to air pollution as well. Generally speaking, it is difficult to transport the present power generator. It is not recommended for users of this generator to frequently travel outside of areas with easy access to fossil fuels or power. Furthermore, when buying a long-term purchase, everyone must also consider the cost. Currently, running and maintaining portable power generators can be rather expensive. According to the study's findings, the power generator we've presented can handle all current issues and will benefit users.

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