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Persistent Pulse Generator

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Abstract

The need for reliable and portable power sources is paramount in today's dynamic and mobile society, particularly in agricultural settings. This research addresses the challenge faced by sugarcane farmers in Ayer Hitam, Johor, who struggle with "Top Borrer" insect attacks on sugarcane stalks. Traditional methods using Haloline Eco Double-ended halogen lamps powered by fuel generators are inefficient due to noise and smoke emissions. This study explores the development of a more sustainable and effective power solution utilizing the principles of magnet and solenoid coil interaction to generate electricity. Through the design and implementation of the Persistent Pulse Generator, which operates without continuous external power sources, we aim to provide a reliable and eco-friendly power alternative. The research employs a comprehensive design methodology, material selection, and engineering analysis to develop the generator. The main findings show that the Persistent Pulse Generator significantly reduces operating costs and enhances the effectiveness of pest control measures. This project concludes that this innovative approach can greatly improve agricultural productivity and sustainability by offering a cleaner and more efficient power source for pest management.

1. Introduction

The need for reliable and portable power sources is growing in today's dynamic and mobile society, especially in outdoor recreational activities and remote work environments. Portable generators provide electricity by running a gas-powered engine that turns an on-board alternator to generate electrical power. Power outlets on the unit allow you to plug extension cords, electric-powered tools and appliances into it [1]. This project aims to design and implement portable generators that can be easily transported to any location, ensuring energy independence and accessibility in situations where traditional power infrastructure is unavailable or impractical

The motivation for initiating this project stems from the critical need for reliable power in modern agriculture. Farms, often located in areas lacking robust power infrastructure, require dependable and adaptable power solutions to support various activities. This project specifically addresses the unique energy requirements of farms, providing farmers with a portable generator that is not only versatile and compact but also efficient enough to be transported across expansive fields and diverse locations.

A particular challenge faced by sugarcane farmers in Ayer Hitam, Johor is the need for a portable generator to combat insect attacks from "Top Borrer" insects. Traditionally, they have used Haloline Eco Double-ended halogen lamps powered by Alternating Current (AC) from houses, extending the power via long extension wires.

However, this method has proven problematic and costly, as the extension wires are expensive and prone to damage from farm machinery.

Therefore, the development of a portable generator tailored to their specific needs could provide a more reliable and efficient power source for pest control lamps, ensuring the protection of their crops without the associated complications of current methods. This project seeks to design and implement portable generators that cater to the evolving energy demands of various sectors, with a specific focus on agriculture.

1.1 Structure

Numerous efforts have been made to develop alternative methods to help sugarcane farmers in Ayer Hitam Johor overcome the challenges of "Top Borrer" insect attacks on sugarcane stalks. The use of Haloline Eco Double-ended halogen lamps is one of the alternative methods to attract these pests. Fuel generators are used as the source of electricity to power up the lamp. However, the effectiveness of these lamps is compromised by the noise and smoke emitted from the fuel generators that were used to light them making the pest attacks remain constant

Despite that, research has focused on exploring alternative power solutions that eliminate these drawbacks. We found a research of free energy concept. However, there is no such thing as Free Energy. Any electricity produced by solar cells, wind, tide, geothermal, or hydroelectric power is only available until we have incurred some initial capital costs for these power-generating technologies. Energy doesn't truly become free until a certain time since the electricity produced by these unusual ways of producing electricity is free of cost.

Thus, the idea of employing magnets to generate energy has existed for a very long time. For a long time, the magnetic field of simple magnets has been used to generate electricity. They fit inside the generator and motor cores. The magnetic effect is the basic principle of power generation. It states that "When a conductor is rotated in a magnetic field, a voltage is induced in the conductor" [7]. So here we will be dealing with such conductors. We came up with an idea that using perpetual concept between the relation of magnet and solenoid coil. Thus, when moving a magnet around a solenoid coil of wire, or moving a solenoid coil of wire around a magnet, it will push the electrons in the wire and create an electrical current. It works on the principle of Neodymium Magnets.

In electric coils in a basic motor produce a magnetic field. These motors continuously need electrical supply to produce magnetic field. However, the magnet motor contains no such coils. Hence, there would be minimal losses. It generates the required force to operate the motor by using permanent magnetic fields of the magnets. The key advantage is that it does not require a continuous electrical source.

From this literature study, generally highlights the ongoing efforts to develop alternative methods for sugarcane farmers in Ayer Hitam Johor to combat "Top Borrer" insect attacks effectively. Traditional ways to overcome the problem has compromised by the noise and smoke by fuel generators produce. Due to that, research into alternative power solutions, including the concept of free energy and magnet-based generation, offers promising avenues. By utilizing the perpetual relationship between magnets and solenoid coils, it is possible to generate electrical current without continuous external power sources. This innovative approach could provide a more reliable and sustainable power solution for pest control lamps, reducing costs and enhancing effectiveness.

2. Methodology

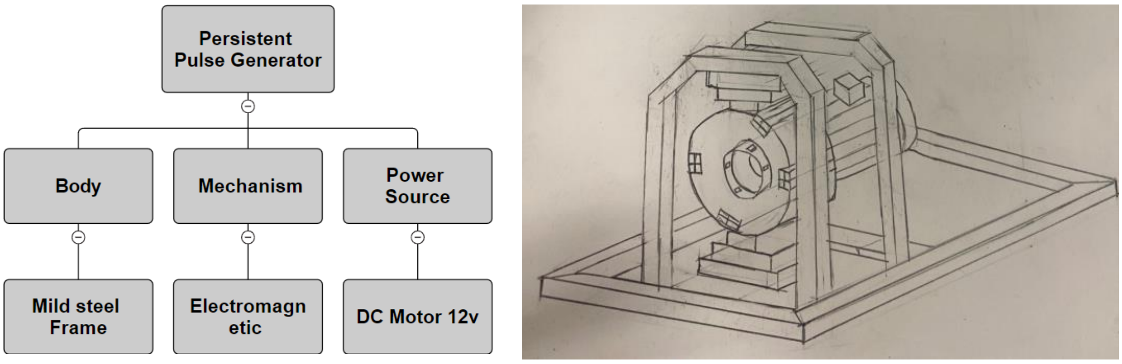
To develop a high-quality product design, an organized manufacturing process is required. The Persistent Pulse Generator. During the initial phase of product development, Finding the user's problem is the first and most important step in the product development process. This is because comprehending the problems at hand could facilitate the resolution process and make it possible to identify products that satisfy the required standards. One of the main characteristics is an affordable and widely accessible design for the user.

Following that, a comprehensive inspection is carried out on the apparatus to confirm its secure operation and ergonomic design. Many options for external design, operating principles, and construction materials were taken into consideration when choosing the design for the portable generator in this project. The **Fig. 1 (a)** that follows shows several elements along with corresponding alternatives for each element. Product Component Decomposition is an approach that involves producing a block diagram to represent the subassemblies that constitute the product. This activity is employed to provide a rough outline of the hierarchical arrangement of component forms and to provide an overview of the relationship between individual components.

Data from the literature review have been compiled based on research. According to this study, there are three main parts to our generator: the mechanism, the body, and the power source. Every single one of these elements is necessary for smooth functioning. The power source powers the entire system, the mechanism facilitates the output, and the body offers structural support. This in-depth comprehension of our generator's parts is consistent with the Product Component Decomposition approach, which emphasizes the connections and hierarchical structure between the different parts.

The coupling, the based structure, and the power source are the three main components that were found to have alternative designs after the Product Component Decomposition approach was applied. The best parts for the portable green sand separator were then chosen using a weighted rating system. Based on factors like cost, weight, ease of maintenance, dependability, and manufacturing feasibility, this system assesses each option.

After selecting a component for each main part of the Persistent Pulse Generator, the concept sketches were chosen to help visualize the design and functionality. **Fig. 1 (b)** presents the chosen concept sketch for this project. Following the selection of components for the main parts of the Persistent Pulse Generator, attention was directed toward the selection and arrangement of features on each part. This process ensured that each component was optimally configured to enhance the overall functionality of the separator. Provides a detailed black box and interaction diagram of the Portable Generator, illustrating the operational workflow from the initial input process through to the final output which the diagram explains how the system operates.

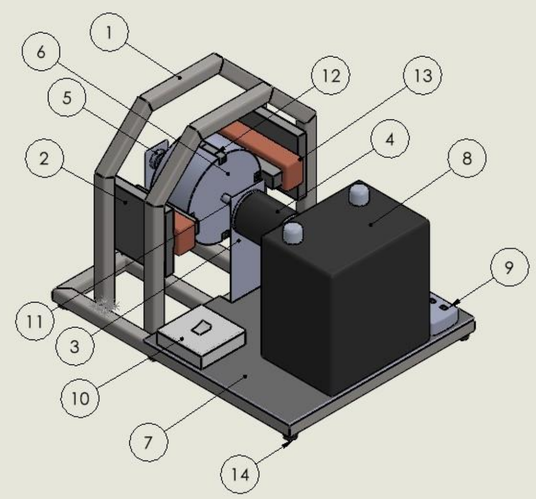


(a) **(b)**

Fig. 1 *Figure description (a) First picture; (b) Second picture*

2.1 Material Selection

Mild steel has been selected for use in the design because it offers greater load-bearing capacity than aluminum and is heavier, which contributes to the stability of the separator as in **Fig. 2**. The use of steel enhances the toughness and reduces bending when the mesh is under load. From an environmental perspective, opting for steel over aluminum is advantageous as it promotes reduced aluminum usage. Furthermore, steel is preferable to aluminum because it is easier to dispose of once the components are no longer in use [3].



NO.	PART	DESCRIPTION	QTY.
1	BASE FRAME	MILD STEEL	1
2	TRANSFORMER	MICROWAVE TRANSFORMER	2
3	PLATE	MILD STEEL PLATE	2
4	MOTOR	12V DC MOTOR	1
5	BEARING		1
6	ROTTO	ALLUMINIUM	1
7	PLATE	MILD STEEL PLATE	1
8	BATTERY	12V BATTERY	1
9	PLUG	3 PIN PLUG	1
10	SWITCH	SWITCH FOR MOTOR	1
11	COUPLING	BRASS MATERIAL	1
12	MAGNET	NEODYMIUN MAGNET	12
13	TRANSFORMER COIL	MICROWAVE TRANSFORMER	2
14	RUBBER	ABSORB VIBRATION	6

Fig. 2 *Assembly Isometric Drawing with Bill of Material using SolidWorks*

2.2 Costing

The total cost incurred for this Final Year Project 2, detailing each component purchased and its corresponding price. The cost of each item reflects current hardware prices available on online platforms like Shopee and Lazada. The key components include a 12V DC Motor priced at RM 70.00, and two transformers costing RM 49.00 each, totaling RM 98.00. Epoxy Resin (A & B) was purchased at RM 18.70 per unit, amounting to RM 37.40 for two units. Smaller items, such as the switch button (RM 2.00), extension plugs (RM 15.00), and rubber foot pads (RM 1.50 for six units), were also included to support the project's assembly and functionality. Additionally, twelve Neodymium magnets were procured at RM 2.10 each, totaling RM 25.20, and a coupling, priced at RM 3.00, was added to ensure proper component connectivity. Two cans of spray were acquired at RM 6.00 each, totaling RM 12.00. Altogether, the project expenses amounted to RM 260.10, as summarized in Table 2, titled "Material Cost."

2.3 Engineering Analysis

The performance of the constructed Persistent Pulse Generator is evaluated based on its effectiveness. To determine the optimal efficiency, mathematical calculations are necessary due to the absence of a tachometer to identify the motor power based on the rotor. The formula used for this calculation is shown equation (1) and (2).

$$T = F\mathrm{r} \tag{1}$$

$$P = T\omega \tag{2}$$

The motor selection process involves calculating the necessary torque and power required to ensure optimal operation of the system. Starting with **Torque Calculation **Eq.1**, torque T is obtained by multiplying the force applied by the rotor's radius. Given that the rotor has a mass of 0.945 kg and a diameter of 0.093 m, the force F can be calculated as the product of the rotor mass and gravitational acceleration, resulting in $F = 9.266\ N$ Therefore, the torque is calculated as $T = 0.862Nm$. Following this, the Power Calculation **Eq. 2** is performed to determine the required power for the system. Power P is calculated by multiplying the torque T by the angular velocity ω, where ω is converted from rotations per minute (RPM) to radians per second. With an operational speed of 1200 RPM, the angular velocity becomes ω = 125.66 rad/s. Therefore, using Equation 2, the power required is $P = 108.32\ W$. In conclusion, based on these calculations, the motor selected should be capable of delivering at least 0.862 Nm of torque and 108.32 W of power to meet the system's operational demands.

2.4 Sustainability

The Persistent Pulse Generator is designed to be as simple and functional as possible to promote environmental sustainability. Key design factors include modularity and ease of maintenance, which facilitate assembly and part replacement. This approach extends the product's lifespan and reduces waste. The inclusion of rubber stands to absorb vibration.

Material selection prioritizes durability and environmental considerations. Mild steel is used for the frame and mesh due to its strength and recyclability, ensuring a long service life and supporting the circular economy. Additionally, we provide paint protection for mild steel material to make sure its anti-corrosion. Components such as batteries and motors are designed for easy replacement or reuse, further promoting sustainability by minimizing waste and conserving resources.

Sustainability principles guide the manufacturing process, which focuses on using less energy and throwing away less trash. Precision cutting and welding are two techniques that help make the best use of energy and minimize waste during production. All this can help conserve natural resources by reducing the need for extracting and processing raw materials. This significantly contributes to reducing the overall environmental footprint of these devices and preserving ecosystems and biodiversity.

3. Results and Discussion

This section presents the results obtained from testing the final prototype of the Persistent Pulse Generator, focusing on its performance, efficiency, and operational characteristics. The objective was to evaluate how effectively the generator could produce a consistent and reliable power output under various conditions, while also assessing any limitations or challenges encountered during testing. Key performance metrics such as output power, stability, and durability were analyzed in comparison to the initial design goals. Additionally, this discussion examines the practicality of the generator for real-world applications, particularly in agricultural environments where portable and sustainable power sources are essential. The insights gained from these tests provide a foundation for potential improvements, addressing factors such as material choices, design adjustments, and energy efficiency optimizations. Overall, this evaluation highlights the effectiveness of the Persistent Pulse Generator as a novel, eco-friendly power solution.

3.1 Product Specification

The specifications of the Persistent Pulse Generator are detailed in Table 3. The generator features a compact base measuring 0.43 m by 0.335 m by 0.3 m, with a rotating mechanism as the primary operation mode. It includes a 93 mm diameter rotor and utilizes Neodymium magnets, each measuring 30 mm by 10 mm by 2 mm, for enhanced magnetic force. The motor power is rated at 120 W, ensuring reliable operation and efficient power generation.

Fig. 3 illustrates the complete assembly and main components of the Persistent Pulse Generator, which include the body, rotor, coil, motor, and battery. The operating procedure for safely using the generator is outlined below. First, safety glasses should be worn, and the generator placed on a stable, flat surface. Verify that all components are in good condition and disconnect any previously connected electrical devices. After turning on the generator switch, allow it to run for a few minutes to stabilize. Next, connect appliances or devices, starting with those that are most critical. Once connected, the generator is ready for use. Upon completion, turn off the generator, clean it thoroughly, and lubricate the rotating parts before storage to ensure longevity and reliable performance.

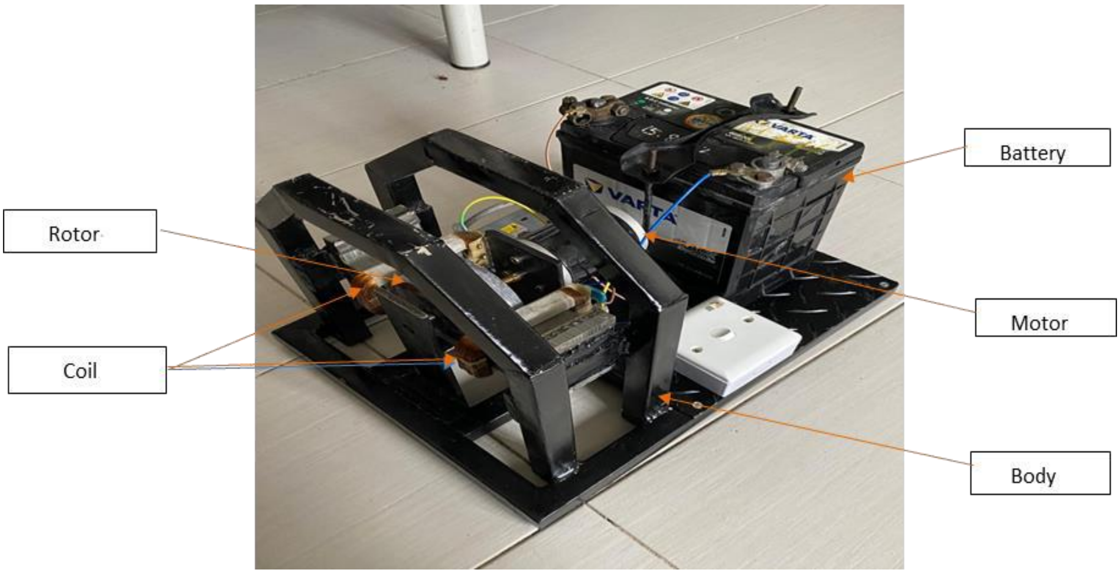


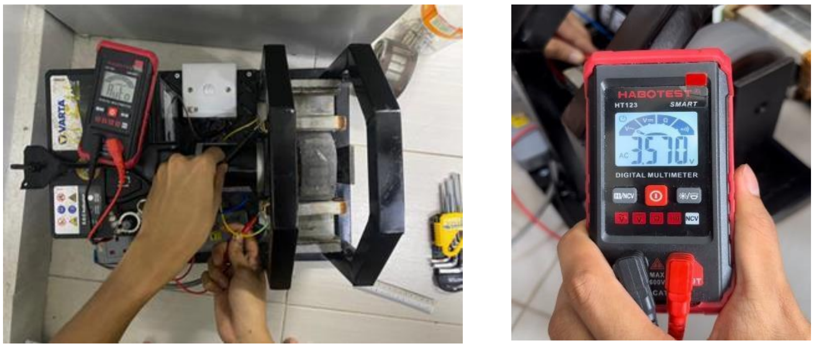
Fig. 3 *Final Prototype of Persistent Pulse Generator*

3.2 Operating Procedure

The operating procedure for the Persistent Pulse Generator involves several important steps to ensure safe and effective usage. First, always wear safety glasses when operating the generator to protect against any potential hazards. Place the generator on a flat, stable surface to prevent movement during operation. Before turning it on, inspect all components to ensure they are in good working condition. Disconnect any electrical devices previously connected to the generator. Once ready, switch on the generator and allow it to run for a few minutes to stabilize before connecting any appliances or devices. Begin by plugging in the most essential items first. After confirming that the generator is functioning properly, it is ready for regular use. When finished, switch off the generator and disconnect any connected devices. Finally, clean the generator thoroughly, and apply lubrication to the rotating parts before storing it. This routine maintenance helps to keep the generator in optimal condition for future use.

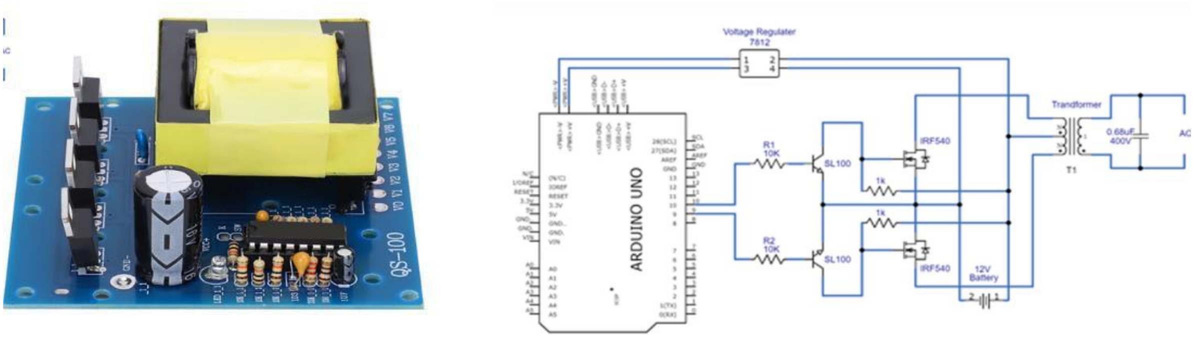
3.3 Prototype Testing & Result Analysis

A performance test of the Persistent Pulse Generator was carried out at the Teaching Factory, UTHM Pagoh, with the primary goal of determining the output of electricity generated by the Persistent Pulse Generator. As shown in **Fig. 4**, the technique includes starting the generator and using a multi-meter to measure the generator's output electricity. The results showed that the Persistent Pulse Generator produced an output of electricity. However, it is slightly below our expectations for the total amount of voltage needed, which is 12 volts. We only got 3.570 volts of output from the Persistent Pulse Generator. Adding a capacitor to the motor can increase and stabilise the output voltage because the RPM and speed of the motor also increase [6]. In future work, Inverter will be used to increase the output voltage up to 240 volts. In **Fig. 5**, the inverter is a separate module. Several factors can contribute to this, including a lack of neodymium magnets and transformer coils at the Persistent Pulse Generator. This issue causes a very little flux between the magnet and the transformer coil [2].



(a) (b)

Fig. 4 *Performance Test (a) Using multimeter to calculate output electric; (b) Output Display*



(a) (b)

Fig. 5 *Future work (a) Module Inverter (b) Module Inventor Circuit*

The graph shows a relationship between time (t) in seconds and voltage (V) in volts generated by the Persistent Pulse Generator. The graph in **Fig. 6** indicates a linear increase in voltage as time progresses, suggesting that the generator builds up voltage steadily over time. Starting from an initial voltage of around 2 volts at 2 seconds, the voltage output increases incrementally with time, reaching approximately 12 volts by 52 seconds.

This steady rise in voltage over time indicates a consistent energy generation pattern. The linear nature of the graph implies that the generator operates efficiently under stable conditions, producing a predictable and gradually increasing output. Such behavior could be due to the characteristics of internal components, such as the rotating mechanism, magnets, and coils, which interact continuously to produce electrical energy at a steady rate.

The gradual increase and stability in voltage output suggests that the Persistent Pulse Generator could be suitable for applications where a reliable and consistent power source is required. Additionally, the smoothness of the curve without any significant fluctuations or drops indicates that the generator design is stable, with minimal disturbances affecting its performance during the observed timeframe. This makes the generator potentially viable for steady, low-power applications.

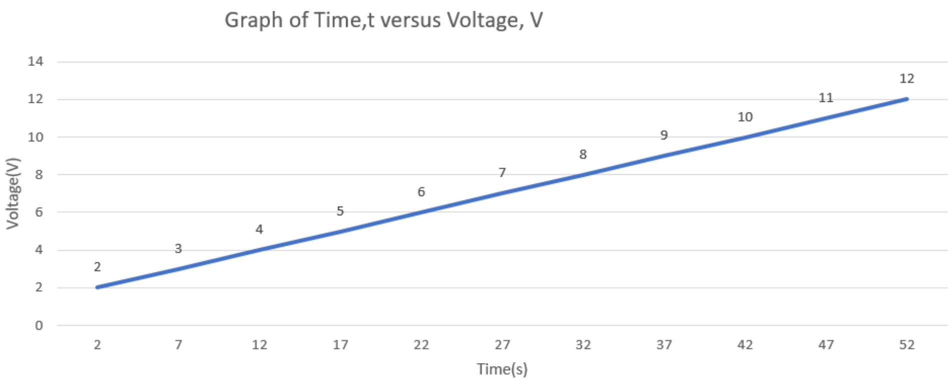


Fig. 6 *Voltage Output over Time for the Persistent Pulse Generator*

3.4 Structure Stability Test

A structural stability and friction test of the Persistent Pulse Generator was conducted by observing the balancing and friction at the rotating part. When the generator is turned on, there is vibration which can be reduced by using a rubber foots pads to absorb the vibration and steady the generator's position. The material of the footpads keeps the structure stable since rubber absorbs energy from impacts or vibrations and quickly returns to its original shape making it ideal for shock-absorbing and dampening applications.

3.5 Component Functionality Test and Analysis

The operational analysis of the Persistent Pulse Generator during assembly highlights the integration and functionality of key components, such as the rubber foot pads, motor, battery, rotor, neodymium magnet, and transformer coil. Each component plays a crucial role in ensuring the generator operates smoothly and efficiently. The rubber foot pads, for instance, are essential for keeping the generator stable and absorbing impact, which helps prevent vibrations during operation. The rotor, mounted precisely, rotates smoothly on its axis, contributing to stable performance without imbalances. The neodymium magnets and transformer coils work together to generate a sufficient magnetic flux, essential for electricity generation, while the motor achieves a high rotational speed, driving the rotor effectively [8]. The battery not only supplies power to the motor but also serves as an electricity storage unit, ensuring consistent power availability.

Despite the robust design, prolonged usage reveals potential wear on the coupling's screw, which connects the motor and rotor. Over time, this wear can loosen the connection, reducing efficiency and requiring maintenance. This observation underscores the importance of careful component selection and precise manufacturing processes in achieving optimal functionality and durability. The analysis demonstrates that paying attention to both production quality and component selection can significantly enhance the generator's performance and longevity.

3.6 Component Functionality Test and Analysis

According to the analysis, ergonomics play a crucial role in ensuring user safety, ease of use, and comfort in the design of the Persistent Pulse Generator. Various ergonomic features have been incorporated into this generator, including an accessible switch, a battery power source, and a vibration absorber [4]. The analysis indicates that this generator is highly ergonomic. The easily accessible switch enhances user convenience, allowing for simple and intuitive operation. Additionally, the use of a battery as the power source offers significant safety benefits by reducing noise levels, unlike traditional diesel-powered generators, which are extremely loud and can pose risks to human hearing. Furthermore, the Persistent Pulse Generator is designed to minimize vibrations, enhancing user comfort. This is achieved through the inclusion of rubber foot pads, which effectively absorb vibrations during operation [5].

4. Conclusion and Recommendations

In conclusion, completing this final year project was a huge accomplishment that demonstrated the value of teamwork, advice, and perseverance. The project not only improved our technical skills and knowledge, but also helped us gain a better understanding of practical applications in our profession. The wonderful assistance of our supervisors, colleagues, and institutions has been critical in overcoming obstacles and reaching our goals. This project is a monument to the hard work and dedication of everyone involved, setting the path for future innovations and professional development.

To improve the efficiency and efficacy of the Persistent Pulse Generator, several significant changes are recommended. Increasing the number of magnets and transformers will enhance the magnetic flux, indirectly raising the output. Replacing the mild steel in the base structure with lightweight materials will make the generator easier to transport while maintaining its strength and durability. Additionally, incorporating a capacitor can boost the output to 12V. Enhancing the performance of the rotating component by using high-quality bearings and lubrication oil is another key improvement. Lastly, installing a plastic barrier around the rotating component will ensure safety. Together, these changes will significantly enhance the generator's convenience, usability, and overall efficiency.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***concept and design****: Muhammad Kamarul Adam Khamal;* ***data collection****: Muhammad Ameerul Haeqal Johar and Haikal Ammar Haslinizam;* ***analysis of results****: Haikal Ammar Haslinizam, Muhammad Ameerul Haeqal Johar and Muhammad Kamarul Adam Khamal;* ***draft manuscript preparation****: Khairulnizam Othman. All authors reviewed the results and approved the final version of the manuscript.*

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