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Development of Digital and Green Technology on Post Pandemic Era

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TSET 2022

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Preface: Proceedings of the Transdisciplinary Symposium on Engineering and Technology (TSET) 2022

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PREFACE: Proceedings of the Transdisciplinary Symposium on Engineering and Technology (TSET) 2022

"Development of Digital and Green Technology on Post Pandemic Era"

It is with great pleasure to welcome you to Transdisciplinary Symposium on Engineering and Technology (TSET) 2022 hosted by Universitas Dian Nusantara on September 21, 2022. The event aims to a venue for engineers, researchers, scholars, and policy makers to explore the challenges and opportunities from the post pandemic era on civil engineering, mechanical engineering, electrical engineering and computer science. For civil engineers, they will play a significant part in the recovery since design and construction services will be needed in the future, and they need to develop new construction methods, materials, and technologies in order to build a sustainable and resilient infrastructure. For engineers, they need to start thinking about the long-term change of their operations and adapt to the "new normal" that has emerged because of the epidemic. We welcome all parties to share their research and thoughts in the symposium.

Participants of the symposium were invited to submit their papers and disseminate them through oral presentation covering such scope as civil engineering, mechanical engineering, electrical engineering and computer science. To enrich the discussion under the theme of "Development of Digital and Green Technology on Post Pandemic Era", we invited speakers with reputable expertise, namely Prof. Josaphat Tetuko Sri Sumantyo, Ph.D. from Chiba University, Japan; Prof. Dr. rer. nat. Evvy Kartini, M.Sc. from National Nuclear Energy Agency of Indonesia; Prof. Dr. Ir. Bambang Sugiarto,, M.Eng. from Universitas Indonesia, Indonesia; and Sulfikar Amir, Ph.D. from Nanyang Technological University, Singapore. In addition to presenting their research results, the participants of the symposium were also encouraged to submit their papers to be proposed for publication to American Institute of Physics (AIP), one of the world's top publishers as conference proceedings. There were 125 manuscripts submitted to the committee comprising 99 papers of Biology, Chemistry, Computer Science and Technology, and Engineering.

Finally, on behalf of the editors of TSET 2022, I would like to extend my most sincere gratitude to the organizing committee, co-hosting institutions, and most importantly, participants, speakers, presenters, and authors of the symposium. I do hope the proceedings bring significant contribution, particularly to the field of advances of sustainable engineering. I look forward to seeing you all at the upcoming symposium.

The Editors,
Ade Gafar Abdullah
Desi Ramayanti
Henri Septanto
Yohanes Galih Adhiyoga

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Yanatra Budi Pramana; Ilham Jangkit Pamuncak; Rusdiyantoro Rusdiyantoro; M. Nushron Ali Mukhtar; Sotyohadi Sotyohadi

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Istihanah Nurul Eskani; Edia Rahayuningsih; Widi Astuti; Bidhari Pidhatika

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Retno Utami; Iman Ruchiat; Yackob Astor; Atmy Verani Rouly Sihombing; R. Desutama Rachmat Bugi Prayogo; Dewi Amalia Pertiwi; Reghina Mulya Sari

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Planning of bicycle lane as sustainable transportation to support post pandemic adaptation in Cimahi city, Indonesia

Agah Muhammad Mulyadi; Anisa Mardiyanti Putri; Sally Nuraeni; Fairuz Albi Asyhari; Aldo Organami; Hanafi Hanafi

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D. Febriansyah; R. Harmadi; K. Herbandono; Faisal Faisal; C. S. A. Nandar

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Utilization of unmanned aerial vehicle for pavement condition evaluation with surface distress index method on the Bandung-Subang road, Indonesia

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Ghestiar Kharisma Kusumo; Agung Witjaksono; Maria C. Endarwarti

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Landslide mitigation through NDSI-based soil erodibility value prediction on coffee land in Wajak subdistrict, Malang Regency, East Java

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A medicine and food delivery robot for Covid-19 hospital using Labview MyRIO FPGA

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Rahayu Khasanah; Masih Ingdana Fadillah; Imam Sodikin; Joko Susetyo

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Real-time structural health monitoring (SHM) using strain gauge Arduino sensor at reinfocement concrete under static and impact loading

Vega Aditama; Sri Murni Dewi; Ari Wibowo; Ming Narto Wijaya

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Voltage stability analysis using probability density function with real load on Karangploso's Feeder Singosari distribution system

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Muhammad Nelza Mulki Iqbal; Antonio Heltra Pradana; Debby Budi Susanti

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The first order Fischer-Tropsch reaction rate constant calculation from carbon monoxide based conversion data

Jimmy Jimmy; Elvianto Dwi Daryono; Harimbi Setyawati

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RESEARCH ARTICLE | JULY 12 2024

Alternating current electric generator design simulation using PhET simulator

Djoko Untoro Suwarno

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Alternating Current Electric Generator Design Simulation Using PhET Simulator

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Abstract. The need for renewable energy causes a lot of research related to energy harvesting. Much research on renewable energy has been carried out on the topic of energy measurement. The energy produced is still low, this is due to the selection of the generator that is not quite right. In general, research on energy harvesting uses motors as generators with high rotation. In this study, a generator design simulation was carried out to convert mechanical energy into electrical energy. The simulation uses PhET simulation. The simulation is carried out by changing the speed of the magnet, changing the distance between the coil and the magnet, the intensity of the magnet, and the number of coil turns. The simulation results obtained for an AC power generator depend on the location of the coil, the configuration of the coil, the number of turns of the coil, the type of magnet, the distance between the magnets, and the orientation of the rotating magnets and speed. The importance of this research students can find out the factors to increase the voltage generated from the generator.

INTRODUCTION

Currently, energy independence is increasingly needed, renewable energy trends such as energy from wind, energy from water, small scale such as micro hydro (small scale hydropower), small wind power. To convert mechanical energy such as motion into electrical energy, an electric generator is needed. An electric generator follows Faraday's law of induced voltage. The coil that cuts the magnetic field will produce an induced voltage. Magnetic fields can come from permanent magnets or electromagnets. Based on the construction, permanent magnet generators are distinguished from the direction of the magnetic field, namely generators with radial magnetic fields and generators with axial magnetic fields. The design of a hybrid generator that combines axial and radial flux directions was carried out by Ichikawa [1] with an energy density of up to 9x greater than commercial generators. The design of the axial flux direction generator was carried out by Garrison [2] for a student project for one semester. Design using finite element analysis for 3D electromagnetics is not realistic for students in one semester, so the design is done analytically. An axial generator connected directly to a wind generator was carried out by Chan [3] with the results following Faraday's law of induced voltage. The use of PhET for physics learning is carried out by Katerine [4], the use of PhET helps understanding physical phenomena. One of the applets from PhET is about generators, through this applet it is easy to learn the generator phenomenon and the application of Faraday's law. The generator for low speed carried out by Bossche [5] proved a low-speed generator using an axial and permanent magnet generator design. In this paper, we will examine generator simulation using PhET. The generator observations include the effect of the number of turns of the coil, the measurement of the magnetic field around the magnet, and the effect of the strength of the magnetic field on the induced voltage that occurs. Analysis of the direction of the magnetic poles and the movement of the magnetic poles to changes in the magnetic field.

The novelty of this research includes using the method of measuring the intensity of the magnetic field to produce an electromagnetic vector field. Method of measuring the magnetic field intensity when there is a change in magnetic poles to prove the contribution of Lenz's law to Faraday's law.

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THEORETICAL BACKGROUND

Faraday’s Law voltage induction is shown in Eq.1

$$emf = -N\frac{d\Phi}{dt} \tag{1}$$

Where emf is electromotive force, voltage induces from coil [in Volt]
N is the number of wire turn in the coil
Φ is flux magnetic [Weber]
$d\Phi/dt$ is a rate of magnetic change [Gauss m2s-1]

Magnetic flux is equal to magnetic intensity multiplied by Area shown in Eq.2

$$\Phi = B\ A \tag{2}$$

Where B is magnetic flux density [Wb/m2 = Tesla]
Ampere's law of the magnetic field around a current carrying wire shown in Eq.3

$$\nabla \times B = \mu_0\ I \tag{3}$$

The electric current (I) in a straight wire produces a circular magnet, the direction of the electric current and the direction of the magnet are shown using Flemming’s right-hand principle. The thumb shows the direction of the current and the finger shows the direction of the magnetic field.

The magnetic field generated from the solenoid also uses the right-hand principle. The circular direction of the coil will produce a magnetic field that is straight on the coil in the solenoid. The direction of the fingers is in the direction of the electric current in the solenoid and the direction of the thumb is in the direction of the magnetic field. The direction of the magnetic field is from the north pole of the magnet to the south pole of the magnetic field.

EXPERIMENTS

This research uses Faraday's law PhET simulation of magnets and electromagnets, generator as shown in **Fig. 1** and **Fig. 2.**

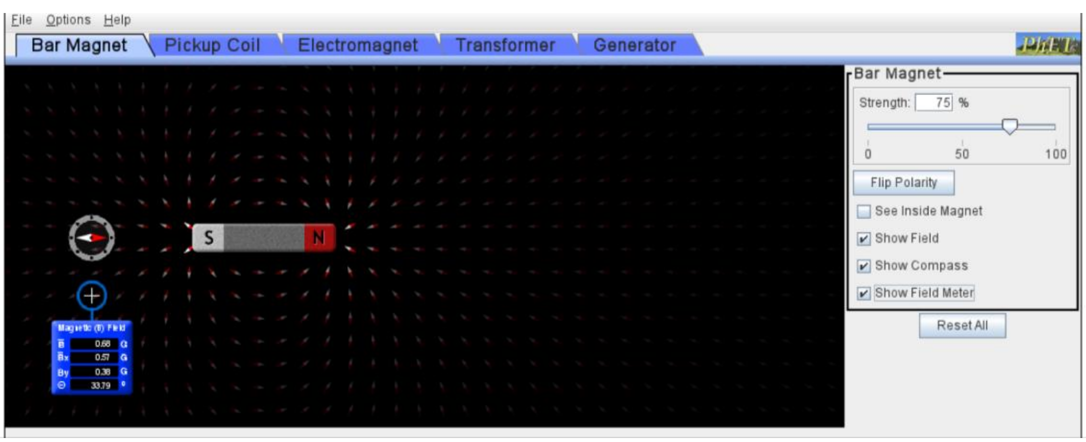

FIGURE 1. Measurement of magnetic field intensity vs. distance using PhET

The first observations about the strength of the magnetic vector field. Measurement of magnetic field strength using measuring tools that have been provided in the simulator.

The second observation is about the direction of movement of the magnet and the resulting induced voltage.

The third observation about the generator, observations includes the effect of the rotational speed of the magnet, the effect of the number of turns of the coil, and the area of the coil on the induced voltage produced.

Observations were made quantitatively (measurement) and qualitatively on the phenomena that occurred. Then an analysis of the observations will be carried out.

The next analysis is a case study for single coil generators, and coupled coil generators.

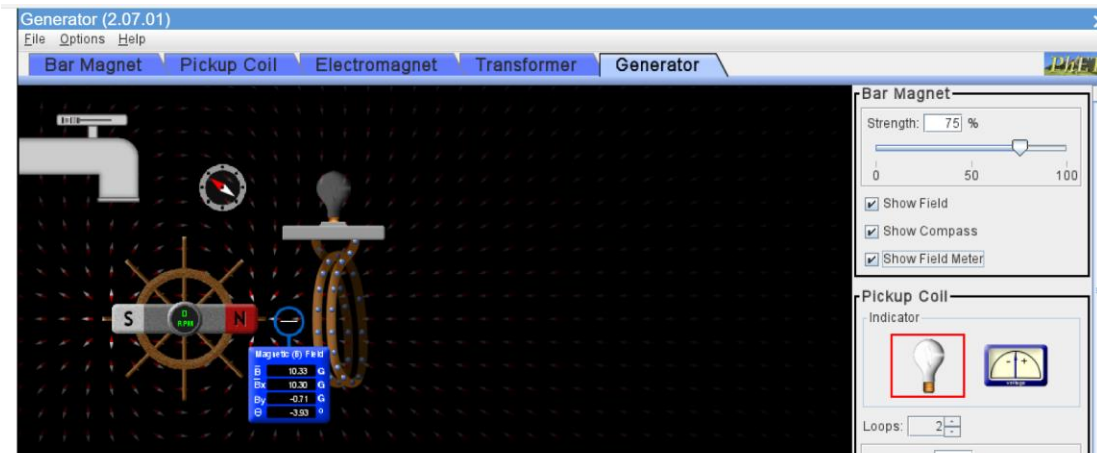

FIGURE 2. Experiment generator using PhET simulator

RESULTS AND DISCUSSION

The effect of distance on the intensity of the magnetic field is shown in **Fig 3**.

Measurement of magnetic field intensity was carried out on a PhET magnet simulator. The intensity of the magnetic field further away from the poles is inversely proportional to the distance. Changes in the intensity of the magnetic field from afar and then closer will produce a negative value of dB/dt, while changes in the intensity of the magnetic field approaching the north pole of the magnet are positive. The measurement of the intensity of the magnetic field inside the magnet is not given and the data is assumed to be zero.

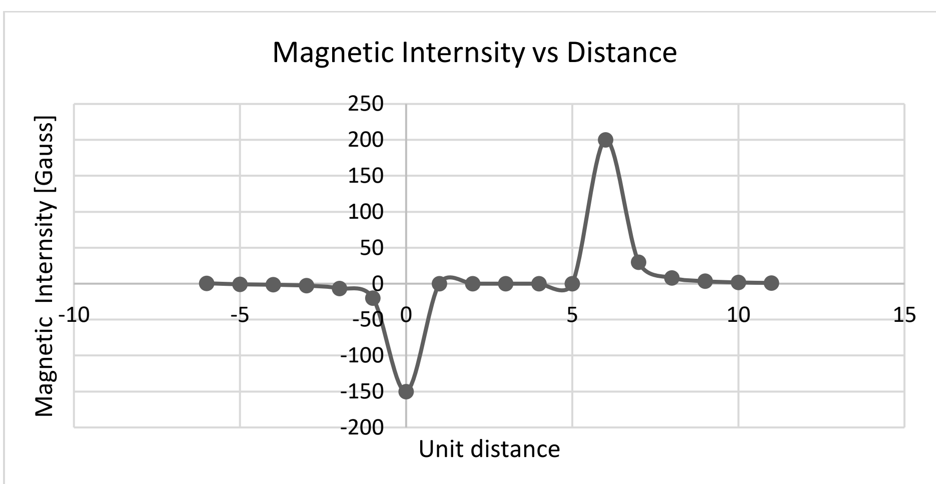

FIGURE 3. Graphics Magnetic Intensity vs distance

Figure 4 shows the movement of the magnet and the direction of the magnetic poles and the changes in the magnetic field that occur. The movement of the magnetic poles which causes the coil to experience a large change in the intensity of the magnetic flux occurs when there is a change in the magnetic field as shown in **Fig. 4a, 4b,** and **4c**.

The movement of the magnet that causes a small change in flux is shown in **Fig. 4d, 4e,** and **4f**, namely the movement of the magnet that does not pass through the alternation of the magnetic poles.

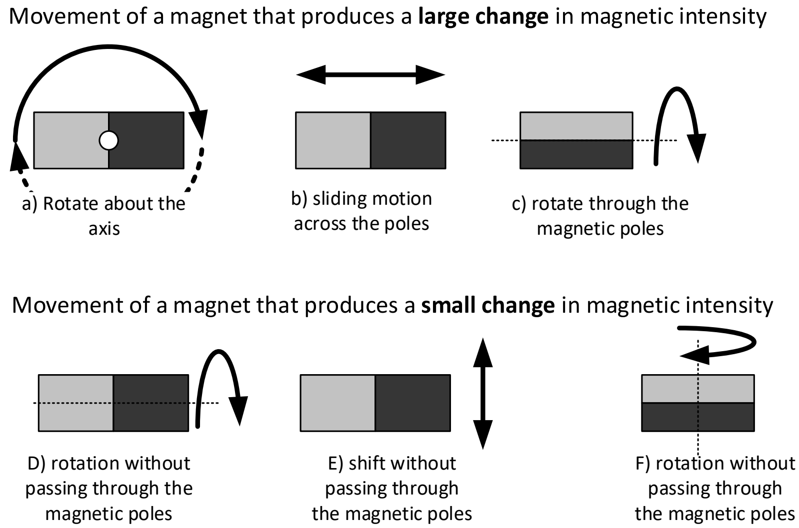

FIGURE 4. Magnet movement and change in magnetic intensity

Figure 5 shows the measurement of magnetic intensity with the angle of the magnetic poles. When the magnetic poles are near the coil, the intensity of the magnetic field is greatest. The farther away the magnetic pole from the coil, the smaller the received magnetic intensity. When the magnetic field is parallel to the coil then the intensity of the magnetic field is minimal. The magnetic intensity in a field is a combination of a magnetic field with an X direction and a Y direction. The wave is formed like a sine wave but leans more towards the bottom.

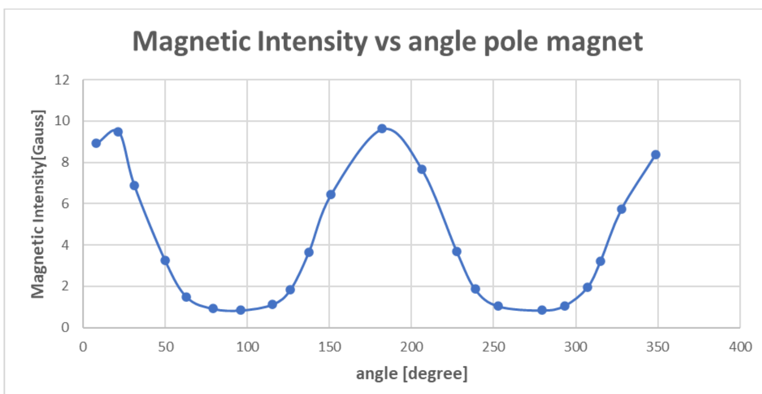

FIGURE 5. Magnetic Intensity vs angle pole magnet

Figure 6 shows the effect of the coil distance on the magnetic field and the induced voltage that occurs. The intensity of the magnetic field is inversely proportional to the distance, the farther the distance from the magnetic poles, the smaller the magnetic field. To get a large magnetic field, the coil must be as close as possible to the magnetic field. For homemade generators, the construction between the rotating magnet (magnetic rotor) and the coil must be close enough but not to cause friction between the rotor and the coil.

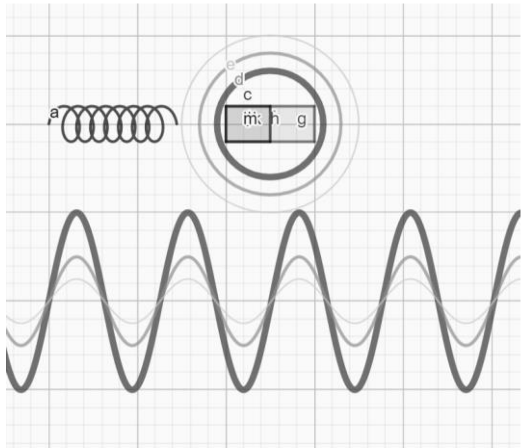

FIGURE 6. The effect of the distance between the coils to the rotor magnet

The closer the coil to the magnetic rotor, the greater the voltage generated. However, it should be noted that the magnetic rotor does not come into contact with the coil, because it will cause friction. The intensity of the magnetic field is inversely proportional to the distance between the coil and the magnetic rotor.

Effect of rotational speed on the induced voltage. The faster the rotation, the greater the amplitude of the induced voltage produced as shown in **Fig 7.**

Magnetic intensity $B = cos(\omega\ t)$ with constant area A, then

$$\frac{d\Phi}{dt} = \frac{dBA}{dt} = A\frac{d\ cos(\omega t)}{dt} = A\ \omega\ sin(\omega\ t) \quad (4)$$

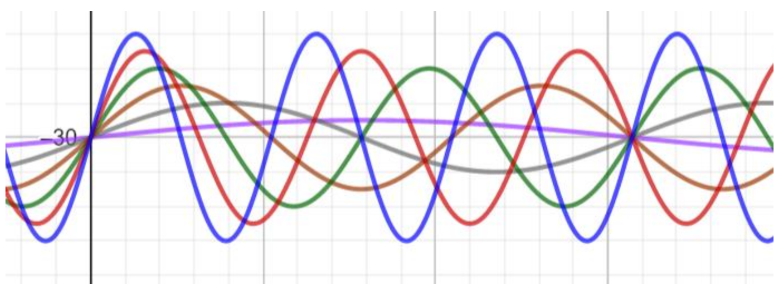

FIGURE 7. Effect on magnet rotation speed vs voltage induce

Hooge [6] in his research on Faraday's law simulations suggests adding questions to students about Faraday's law concepts such as what affects the magnitude of the emf that occurs, the effect of Lenz's law on Faraday's law, the direction of current that occurs is CW, or CCW.

CONCLUSION

From the simulation results can be concluded as follows:

1. the generator follows Faraday's law of induced voltage
2. The induced voltage is proportional to the number of turns of the coil
3. A large concentration of magnetic field occurs in the area near the poles. To get a larger induced voltage, it is necessary to move the magnet in a rotating manner due to a change in the poles, or movement toward the poles.
4. The coil area affects the magnetic flux reception. The more magnetic flux received by the coil, the greater the induced voltage that occurs

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