

Magnetic Levitation Technology As An Object Floating Technique In Wooden Craft



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ABSTRACT

Research and application of magnetic levitation have been expanded in electric motors, generators, radar monitoring systems, car-door *central locks*, and metal object towing devices. In the operation, the objects do not touch each other. The use of a magnet-based system that floats objects is called a levitation system. In earlier times, fine art had been comfortable with its structure. Consequently, it is not prepared to deal with electromagnetic technology systems. Magnetic levitation technology is the process of floating objects with a gravitational force that rejects or counteracts each other in a magnetic field. This research aims to provide innovations in applying magnetic levitation in designing fine artworks in Indonesia, mainly wooden crafts. The work was designed with *eco-design* methods. The magnetic levitation techniques have been widely applied in woodcraft art today. The process of floating objects in the air has the property of rejecting each other's components, while the use of permanent magnets sets the object's position stable. Wood material as an object medium is formed to resemble a flying bird stabilized by magnetic levitation techniques. This wooden crafts experiment featured objects spinning and hovering when exposed to the wind.

Kata Kunci:

Levitasi Magnetik, Objek Pelayangan, Teknik Levitasi, Kriya Kayu.

ABSTRAK (Font Calibri Light, Bold, Size 11)

Penelitian dan penerapan levitasi magnetik telah diperluas di berbagai bidang seperti: motor listrik, generator, sistem pemantau radar, *central lock* dalam pintu mobil, dan alat penarik benda logam. Prosedur operasionalnya tidak saling bersentuhan antar objek satu

dengan objek lainnya. Penggunaan sistem berbasis magnet yang melayangkan objek disebut sistem levitasi. Pada zaman sebelumnya seni rupa telah nyaman dalam struktur dirinya sendiri. Situasi ini menunjukkan kenyamanan dalam struktur dan tidak biasa melebur diri dalam proses sistem teknologi elektromagnetik. Teknik levitasi magnetik adalah proses melayangkan objek dengan gaya gravitasi yang saling menolak atau menangkai dalam medan magnet. Tujuan penelitian ini adalah memberikan inovasi baru penerapan levitasi magnetik dalam perancangan karya seni rupa di Indonesia, khususnya seni Kriya kayu. Metode perancangan karya digunakan metode pendekatan *eco-design*. Penerapan teknik levitasi magnetik di bidang seni Kriya kayu telah menjadi temuan teknik baru saat ini. Proses melayangkan objek di udara memiliki sifat saling menolak antara komponen satu dengan komponen yang lain, sedangkan penggunaan magnet permanen berfungsi untuk mengatur posisi objek agar stabil. Material kayu sebagai media objek dibentuk menyerupai burung terbang yang distabilkan oleh teknik levitasi magnetik. Eksperimen kriya kayu ini menampilkan objek berputar dan melayang ketika terkena terpaan angin.

INTRODUCTION

Human life today is inseparable from the ongoing need for technology and information. The advancement will continue and consequently, the need for technology-based function products also increases. The resulting technology-based products aim to meet human needs and support human activities. The industrial and transportation sectors have applied magnetic levitation. Although many studies of magnetic levitation have been conducted in several countries, Japan has successfully implemented it in the high-speed industry.

Research on magnets has long been carried out and has produced various products that are beneficial to human life. Products that apply magnetic functions include transportation and traffic facilities, electric motors, electric generators, radar monitoring systems, car-door central locks, cargo conveyors, and fast trains (Han and Kim, 2016). This study describes all the technical content and applications, as well as the multidisciplinary aspects of transportation.

Han and Kim's research have explained all the technical content and applications and multidisciplinary aspects of transportation. However, this study of magnets aims to identify a magnetic resistance method called magnetic levitation which is applied in the fine arts sector, especially craft arts. Currently, the field of art has not yet been immersed in technology-based processes. The field of art is still comfortable with its structure, so it is too late to align it with the current trend.

The design of this wooden work aims to apply and develop the Magnetic Levitation technique as a stable balancer in hovering the object of the work. Besides that, it also aims to reduce wood waste which at a certain time will have an impact on environmental pollution.

The basis of the theory of the gravitational force of an object, either magnetism or attraction, can be used to create levitation. Magnetic levitation can operate by providing permanent magnets and electro-dynamic systems. The basis of the theory of the gravitational force of objects is the magnetic force that repels or attracts. This magnetic force can be used to create levitation. To operate magnetic levitation there must be a permanent magnet and an electro-dynamic system. Lenz's law states that an induced electromotive force always generates a current whose magnetic field is opposite to the origin of the change in flux. When an induced electromotive force arises in a circuit, the direction of the induced current can oppose the cause of the effect. Some of the causes for this effect are 1) changing magnetic flux through a stationary circuit, 2) the motion of the conductors forming the circuit, and 3) a combination of the two (Isyanto and Birawan, 2018). Crealev Levitation Design located in the Netherlands has discovered the application of magnetic levitation which uses magnetic repulsion. This company has issued products including "floating displays" and "floating lamps" (Lim et al., 2017).

Hedberg and Hannula in Kjorup explain that artistic research occurs when an artist creates a work of art and examines the creative process. After that, they add the accumulated knowledge of the work and research. Honesty in the practice and process of the artist in preparing, exploring ideas, implementing, testing theory through practice, conducting experiments through a series of experiments, going into the field, and documenting are important aspects of research (Kjorup, 2011).

Carole Gray in Murwanti explains that the principles and definitions of practice-led research can consist of the following: a) First, research is initiated in practice where questions, problems, and challenges are identified and formed from the needs of practice and practitioners, b) Second, the strategy research is delivered through practice, using the dominant methodologies and other more specific methods (Murwanti, 2017). Magnetic levitation is the process of floating objects by utilizing the repulsion of a magnetic field. Referring to the theory of the gravitational force of an object, either repulsive or attractive magnetic forces can create levitation. Magnetic levitation can be used if there is a permanent magnet (Murwanti, 2017).

METHOD

The research method whose results are in the form of works, models, prototypes, and prototypes is called Practice-led Research. This method is an advanced research method or application of practical-oriented basic research in design or other terms "research through design" (Hendriyana, 2018). Practice-based research is a research method that uses design practice to create an evidence base for something demonstrated or discovered. When an artist explores the ability to take responsibility for his work, he has approached it from an academic perspective.

RESULT AND DISCUSSION

Electromotive Force on Magnets

Lenz's law states that "If an induced electromotive force arises in a circuit, then the direction of the induced current is such that it creates an induced magnetic field that opposes the direction of the changing magnetic field (Isyanto and Birawan, 2018).

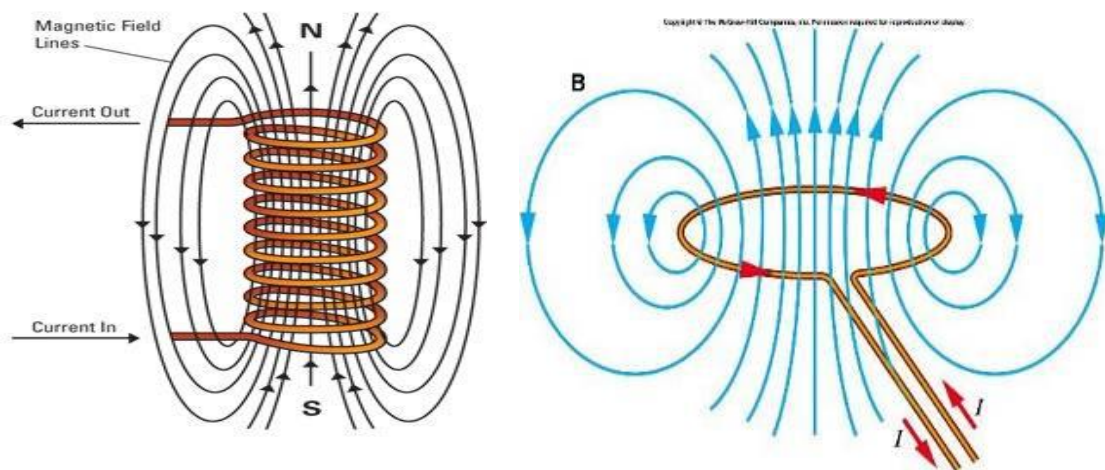


Figure 1. Electromotive Force.

Source: <https://artikel-teknologi.com/macam-macam-generator-ac/>

The magnet and the coil are at rest. Therefore, there is no change in the magnetic flux in the coil. However, when the north pole of the magnet moves closer to the coil, a change in magnetic flux occurs. The coil will cause a magnetic flux that opposes the increase in magnetic flux through the coil, so the direction of the induced flux must be opposite to the magnetic flux. The total flux enclosed by the coil is always constant. The magnet driven by the coil can produce an induced flux that opposes the reduction of the magnetic flux. A ring magnet is useful for generating lift on objects to be levitated. Ring magnets can generate horizontal force due to changes in magnetic flux. The magnitude of the magnetic field generated by the ring magnet is influenced by several aspects.

B = Magnetic Flux Density

F_r = Residual Flux Density

D = Thickness of Ring Magnet

Z = Distance between Polar Area and Magnetic Field at a Point

R_a = Radius of Magnetic Ring

F_g = Object Load



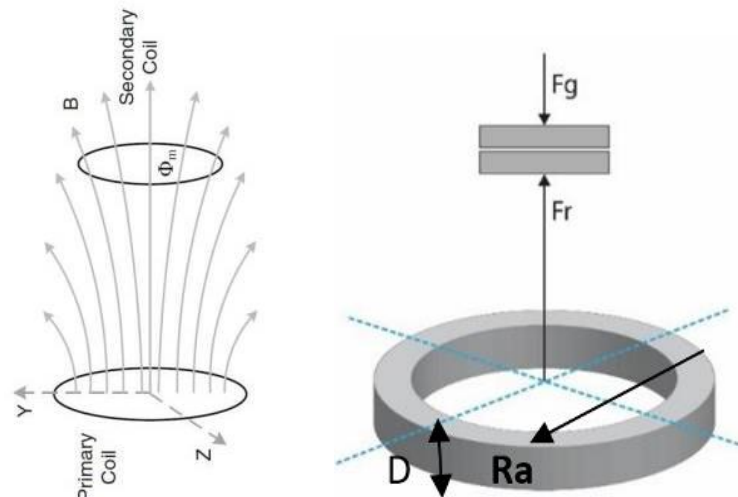


Figure 2. Magnet Field Received by Receiver Coil
Source: (Lim *et al.*, 2017)



Figure 3. Magnetic Levitation Machine Core Kit Modul With LED Lamp.
Source: <https://www.pinterest.ch/pin/6403624461113611/>

For a long time, artworks have been in their comfort zone. The fine arts believe that the position that has been achieved can satisfy itself or the public. Art has found patterns in a permanent structure. Fine art recognizes the values of standard rules of artistic processes. The stipulations or rules that have been agreed upon in the human mind and behavior to produce artworks are called "Pakem" (custom). Adherents of "Pakem" perceive that the artwork has reached the highest aesthetic so that changes and standardization to established theory are not needed violates the artistic process out of the groove. Examples of garuda sculptures that are displayed in public spaces or government offices by Nanang "Garuda" are controversial because the Garuda figure has a richer, more dynamic style. Garuda's figure is static yet expressive from the perspective of the audience's interpretation.

Electric Technology for Artwork Object Driving

Previous research and design refer to the electric motor motion system to move objects permanently. This technological leap is the basis for how works of art that were originally static (not

moving) become more dynamic. However, the resulting movements are monotonous because of the limited movement patterns. Such this application of technology is often referred to as Kinetic work.



Figure 7. Kinetic Garuda by Dedy Sofyanto
Source:<https://www.youtube.com/watch?v=L6RPOsvk-LQ>

Eco-Design Approach

Increasing the passion for Indonesian arts and culture is currently carried out with traditional processes and electro-based machine technology. The two methods are possibly combined to create a new genre in working on Kriya's works. The next effort is to open the mindset of craftspeople to work with inexpensive and environmentally friendly materials. craft media can use production waste materials or leftover materials. The use of waste media indirectly encourages the growth of various sectors of the creative economy industry. This achievement requires a social approach and a wise attitude towards the surrounding environment. The environmental approach can be realized with the attitude and concept of eco-design. The main goal of eco-design is to reduce production costs by utilizing waste, to gain profits, and minimize environmental pollution. Eco-design is an approach to product design by considering environmental impacts throughout the entire life cycle. There are three eco-design principles, namely reduce, reuse, and recycle (Nurjanah, 2020). Ecodesign is a product design approach with special consideration to environmental influences during the entire life cycle process. The three principles of this Ecodesign are described in the following.

a) Reduce, is the attitude of reducing materials and energy and using them as efficiently as possible.



- b) Reuse, is the effort to reuse obsolete or unused products for other useful purposes.
- c) Recycle, is the effort to recycle waste products processed into reusable goods.

The most beneficial relationship between craft and social sustainability is the extent to which craft provides cultural connectivity (Moubarak and Qassem, 2019). Cultural connectivity that maintains current conditions and the environment will have an impact on social and environmental sustainability.

In his research, Judge asserts that the creation of art can be used as the latest discoveries that consider environmental sustainability. Arts and crafts items will be judged to be more sustainable than machine-produced items (Judge et al., 2020).



Figure 8. Waste wood pieces, twigs, and wood roots.
Source: Sumino

Process of Object Work Levitation

The cultivated object in this design focuses on the utilization of sonokembang root waste. Sonokembang wood has large and strong fibers. Sonokembang wood also has a straight and long tree trunk, because people tend to process the trunk rather than the roots. The paradigm or philosophy that says "no rattan, no roots" in recent years has become a real slogan. Many artists have made use of root waste in elegant art products. Initially, the roots have no value, even left brittle in the soil. The processing of wood root waste with various technologies and the right equipment can produce spectacular masterpieces.



Figure 9. Wood Root ArtWork.

Source: <https://www.antaranews.com/video/1742901/kreasi-limbah-akar-kayu-jati-yang-mendunia>

Since Kinetik's work was raised and introduced in the art appreciation space, it has now become a reference for making art with more creative technology and power. The presentation of Kinetic works can move dynamically, uniquely, and aesthetically. However, in making this levitation work, more emphasis is placed on the presentation of the object of the artwork. Dwi Marianto's observations, written in the book "Art and the Power of Life", explain that a school of fish fights a fast water current and jumps around lightly, not because of the strength of the fish against the current. The movement against the current occurs because of the gravitational force and the resistance of gravity (Marianto, 2017). This incident triggered researchers to conduct research and design works based on gravity and gravity rejection, currently better known as levitation.



Figure 4. Process of Wooden Waste Cutting.





Figure 5. Process of Wood Smoothing. Figure 12. Process of Wood Arrangement and Combination.



Figure 6. Levitation-Based Wooden Craft.

CONCLUSIONS

The barometer of the development of craft art should be marked by creative ideas, attitudes, and critical actions. It is not enough to stop at the discourse of one point of view, but it is necessary to expand the paradigm. In the researchers' observations, the technology of craft art has moved slowly against the current of established structures. The issue of "standard" or "rules" in traditional style has no longer represented creative ideas, and more often it follows tradition than invention. Even a group of creators consider this to be a shackle in the development of craft art.

The research work presents wooden craft art based on levitation technology with an eco-design approach. In the current observation, there have been creating products by several craftspeople who ask about the existence of the form and function of a job. Wayang Ukur, Garuda Kenetik, Levitasi Elang, and Levitasi Siger are new genres representing the many craft products that dare to go against structure. This levitation work signifies the passion of craft art to enter new technology.

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