

# Design and Simulation of Self-Running Magnetic Motor

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**Abstract:** The use of magnetic motor to generate electricity ever since in the 18 century. In most cases, external resources such as hydro and wind are needed to power the magnetic motor before an induce electricity can be produced. In this study, a magnetic motor is designed to self-rotate its rotor by naturally repulsion and the attraction of magnetic field by arranging the magnets into Halbach array. The self-rotation magnetic motor sometime it is known as a machine that produce "Free Electric Energy". Based from the results the rotor is rotating at the constant speed that produced the torque that lead to the development of mechanical power

**Keywords:** Halbach Array, Perpetual Motion, Free Energy, Electrical Energy

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## 1.0 INTRODUCTION

The term "free energy" is not maybe a gas station giving away gas however this is not the case for Nikola Tesla where he was the first one to identify "radiant energy" where energy harvesting the Sun. Nikola Tesla is the key researcher in free energy theories and invented most of the free energy devices. Tesla introduced two free energy theories. The earlier is known as Crooke's radiometer and later as "cosmic-ray motor" which he claimed to be "thousands of times more powerful" as compare to Crooke's radiometer. Tesla's free energy concept was patented in 1901 as an "Apparatus for the Utilization of Radiant Energy." In 1932, Tesla claimed has successful harnessed the cosmic rays. The radiant energy receiver stored static electricity obtained from the air and converted it to a usable form <sup>[1,2]</sup>. However, Tesla's free energy are not from the magnetic motor generator that produce the electricity.

In this study, a free energy is created from permanent magnet motor without utilizes resources from outside such as burning fossil fuels namely coal, petroleum and natural gas <sup>[3]</sup> to induced voltage. The free energy comes from the naturally repulsion and the attraction of magnetic field that creates the motion of electric motors. This self-running electric motors is attached to a turbine motor shaft which resulting an induced voltage. The term, "Free Energy" is widely used and often abused in the industry. Many believe no such thing of free energy, or whatsoever

machine capable to generate energy out of nothing. In others word, there are no such things of "perpetual motion machine" that can do work continues indefinitely without utilizing external energy.

## 2.0 PERPETUAL MOTION DEVICES

### 1. History of Perpetual Motion Devices

Perpetual motion devices were claimed and existed since pre-1800s year which in mid-age Renaissance. Not only that, Wilkins was the first inventor of the inventions using a magnet. The device is not successfully working because magnet pull a ball upward the slope and towards the hole, the top finally fell to cycle back to the originator <sup>[4]</sup>.

### 2. Muammer Yildiz Motor

Muammer Yildiz has developed a permanent magnet motor in power who do not use external source of power such as batteries, radioactive or other<sup>[5]</sup> as shown in Figure 1. This device has the axis of the drive shaft 5 rotating supported so that it rotates in the stator, which is surrounded by the stator outside the rotor firmly connected to the drive shaft. Outside the stator has a magnetic dipole placed on the surface of a circular cylinder, while the external magnetic evenly spaced around the cylindrical surface around it. This invention is a device to generate an alternating magnetic field that interacts with the magnetic field that is not moving. The interaction of the stationary magnetic field with an alternating magnetic field was applied, three cylinders are produced, the first stator

magnet, second magnet rotors as they rotate around the axis of the shaft and the stator magnet past the outside. The three-axis, three-cylinder is similar to the shaft axis. Magnet internal stator, rotor, and the outer stator have a magnetic orientation that causes them to repel each other at every angular position of the rotor. According to the authors, Yildiz motor is capable of producing a mechanical power output of 250 Watt where the magnetic motor having the diameter of 20 cm and a length of 40cm is producing 15,000 rpm [6].

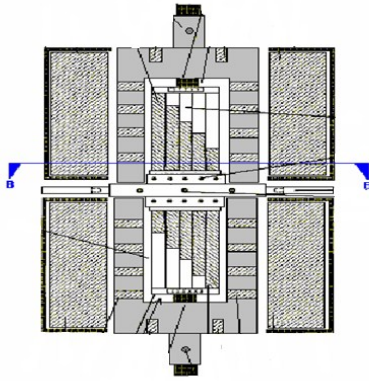


Figure 1: Yildiz Motor

### 3.0 THE DESIGN OF MAGNETIC MOTOR

In ensuring the success in designing the Halbach array magnetic motor it's important to proper select the magnet material, the size and shape to the magnet as explained in the sub-section below.

#### a. Material Selection

Magnets have different types and different strengths depending on the type of material used. In this design Neodymium type N52 magnet is used. Table 1 below clearly demonstrates the specification of the magnet [7].

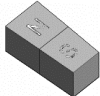


Table 1: NdFeB Magnet Material Properties

Remanance (Br)		Coersive Force Hcb (Hc)		Intrensic Coersive Force Hcj (Hj)		Maximum Energy Product (BH) Max	
mT	G	K A/M	Oe	K A/M	Oe	KJ/m <sup>3</sup>	MGoe
1430	14300	796	10000	876	11000	398	50

#### b. Shapes and Sizes of Magnet

The process of size selection and magnetic form is an important part because the force to be generated depends on the magnetic field that occurs between the magnetic reactions in the motor. In the design of this magnetic motor will use 3 different shapes and sizes as shown in Table 2.

Table 2: Shape and Size of Magnet [8]

Shapes	Size
	25mm x 75mm x 50mm
	25mm x 100mm x 25mm
	20mm x 20mm

#### c. Magnetic Circuit and Operating point

Design of the configuration magnetic circuit, the operating point should be set to determine the energy transferred from the magnet to the gap having a strength energy [9]. Ideal circuit considerations set in infinite magnetic permeability of magnetic materials are infinite so that their anxiety can be ignored. The number of MMFs in the circuit is equal to zero, an important line of lines in the magnetic field along the circuit as follows:

$$\int H \cdot dl_{magnet} + \int H \cdot dl_{gap} = 0 \quad (1)$$

$$H_m L_m + H_g L_g = 0 \quad (2)$$

$$H_m L_m = -H_g L_g \quad (3)$$

$H_m$  is the magnetic field of the magnet in A/m

$L_m$  is the length of the magnet in m

$H_g$  is the magnetic field of the gap in A/m

$L_g$  is the length of the gap in m

Modelling the curve, the continues negative flux resulting the flux on external space can be equal to the total flux in the magnet.

$$A_m B_m = B_g A_g \quad (4)$$

Multiply equation 3 and 4, hence the result is shown in equation (5)

$$A_m B_m H_m L_m = -A_g B_g H_g L_g \quad (5)$$

$$V_m B_m H_m = -V_g B_g H_g \quad (6)$$

where  $V_m = A_m/L_m$  and  $V_g = A_g/L_g$

The air gap  $B_g = H_g \mu_o$  and  $H_m L_m = -H_g L_g$

The equation (6) becomes:

$$\frac{B_m}{H_m} = -\mu_o \frac{A_g L_m}{A_m L_g} \quad (7)$$

The Ratio  $\frac{B_m}{H_m}$  on the geometry is only dependent of the magnet circuit.

As can be seen in equation (7), the geometric circuit magnet is dependent on the slope line load. Therefore, the air gap inside the motor and the linear movements are the dimensions is variable, the line load will also vary. In practical terms, a safe way to handle the leakage magnetic flux and the finite magnetic permeability by introduced the two new quantities, the leakage coefficient  $K_1$  and the loss factor  $K_2$ <sup>[10]</sup>.

$$K_1 = \frac{\text{Total flux in circuit} = \text{Useful flux} + \text{Leakage flux}}{\text{Useful Flux}} \quad (8)$$

$$K_1 = \frac{\text{Magnetic MMF}}{\text{Useful MMF}} \quad (9)$$

Equation (7) the total load line becomes<sup>[11]</sup>:

$$\frac{B_m}{H_m} = -\mu_s \frac{K_1 A_g L_m}{K_2 A_m L_g} \quad (10)$$

#### d. Design of Magnetic Field Using Halbach Array Method

The configuration of the magnets in the self-running magnetic motor in this study using Halbach array. The simplest Halbach array configuration and its magnetic field lines as shown in figure 2. The halbach array configuration is creating strong magnetic field at one side while cancelling the field to near zero on the others side of the array.

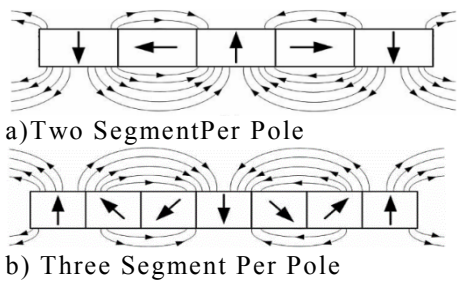


Figure 2: Halbach Array Configuration

The self-running magnetic motor is designed with 3 layers as shown in figure 3. The most inner magnets consists of 10 magnets, the middle magnets is made of 14 magnets and the outer magnets is comprises of 21 magnets. The magnets field arrangements follow Halbach array<sup>[12]</sup>. The middle and the outer layers are the stator whereas the

most-inner layer act as rotor. The inner radius of the magnets is at 4.1cm, the middle magnets radius at 6.4cm and outer magnets radius at 1.7cm with an air-gap of 0.3cm between the magnets. The whole radius of the design is at 12.5cm.

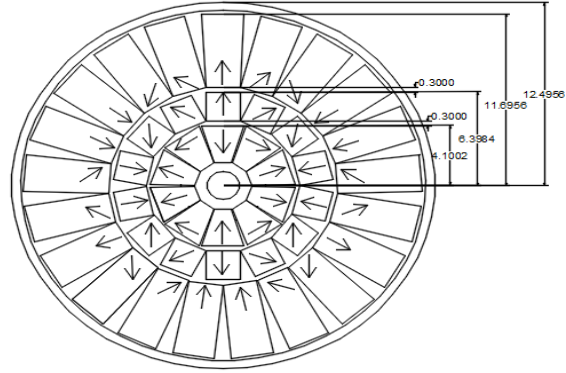


Figure 3: Self-Running Magnetic Motor with Halbach Array Method

The magnetic field gradient can be calculated via analytically for any chooses circular geometry. Elemental field dB a radial distance (r) from the source of the magnetic field can be used Biot-savart law.

$$B = B_o \frac{1}{r^2} \quad (11)$$

The disarrange field decay with  $B_o$  will be given by

$$B = B_o \frac{\theta^2}{\alpha^2} \quad (12)$$

From the magnetic field source at the distance, r can be replaced by equation 12, to explain the decaying field in terms of<sup>[13]</sup>.

$$\frac{B}{B_o} = \frac{\theta^2}{\alpha^2} \quad (13)$$

$B_o$  is the quantity in the nearest magnetic area where the arc circle  $\theta$  is the angle between two slots.

$$\frac{dB}{d\theta} = \frac{d}{d\theta} \left( B_o \frac{\theta^2}{\alpha^2} \right) = B_o \frac{2\theta}{\alpha^2} \quad (14)$$

#### e. Torque

Moment of magnetic dipole depends to a magnetic field

gradient  $\frac{dH}{dX}$  can be equal to

$$F = \mu_o m \frac{dH}{dX} \quad (15)$$

Equation (15) can be transformed from the Cartesian to polar coordinates and can be equal to

$$F = \mu_0 m \frac{dH}{d\theta} = m \frac{dB}{d\theta} \quad (16)$$

Magnet magnetization of the rotor is considered to be always parallel to the stator magnet, thus rotating the rotor on its axis. Therefore, the torque experienced by the rotor radius r when subject to force F is:

$$T = r \times F = \begin{matrix} \alpha_x & \alpha_y & \alpha_z \\ 0 & r_y & r_z \\ 0 & F_y & F_z \end{matrix} = -\alpha_x (r_y F_z - r_z F_y) \quad (17)$$

Therefore to determine the analytical torque, two quantities are known as r & F<sup>[14]</sup>.

$$T_x = r m \frac{dB}{d\theta}$$

Therefore, the induction torque on the rotor has only one component, therefore, if the modulus of magnetization is taken equal to the value of each magnet, then the total T depends on the upon is the gradient  $(\frac{dB}{d\theta})$ . Figure 4 shows the 3D design of the self-running magnetic motor

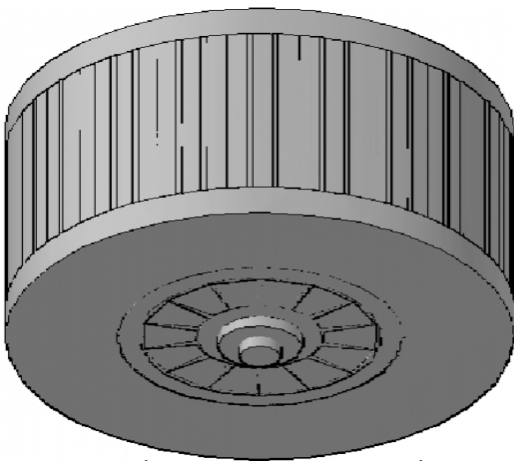


Figure 4: The 3D Design of Self-Running Magnetic Motor

#### 4.0 SIMULATION RESULTS

The self-running magnetic motor design is tested using Finite Elements simulations tool. The Finite Elements FEMM4.2 is an open source magnetic motor that provide wide range of possibilities to simulate the design. Figure 5 shows the magnetic field strength of the self-running magnetic motor obtained from FEMM4.2

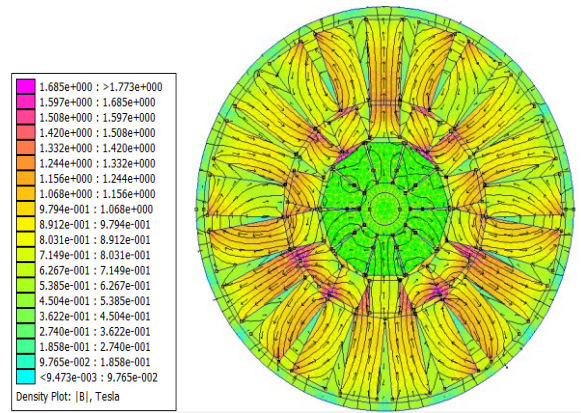


Figure 5: The magnetic field strength of Self-Running Magnetic Motor

Figure 6 show the RCF response from the simulation that the rotor is rotating at a constant speed. Figure 8, shows the torque response. As expected it produced two cycles from 360° turn from the self-running magnetic motor. From equation (18) the revolution per minute (rpm) of the rotor in the self-running magnetic motor can be calculated. The rpm is needed as it is part of the equation (19) to find the mechanical power.

$$RPM = \sqrt{\frac{RCF}{r \times 1.118}} \times 1000 \quad (18)$$

Where,

Rpm is revolution per minute

RCF is relative centrifugal force

R is centrifugal force radius in mm

From (18) the rpm can be plotted as shown in figure 9.

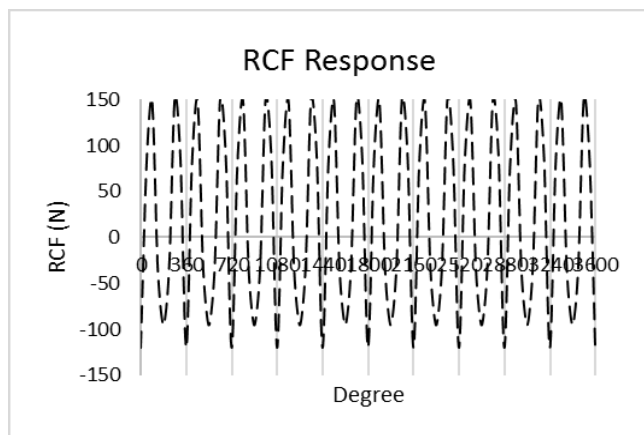


Figure 6: RCF response of Self-Running Magnetic Motor

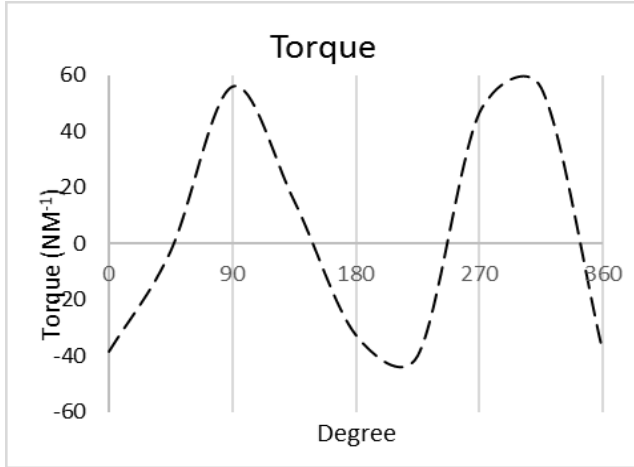


Figure 7: Torque simulation response of Self-Running Magnetic Motor.

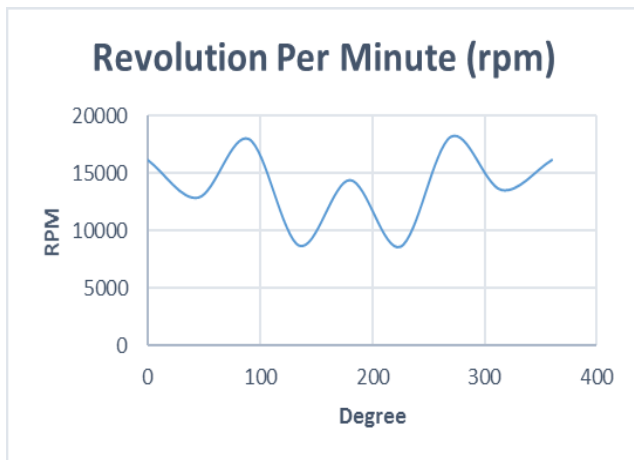


Figure 8: Revolution per minute (rpm) response

Once torque is obtained the mechanical power can be calculated by using the equation shown in (19):

$$\text{Power Mechanical} = \text{Torque} \times \text{RPM} \times \frac{2\pi}{60} \quad (19)$$

The main objective of this study and the most important is the capability of the self-running magnetic motor to induce electricity. In normal cases the efficiency of the generator are working around 90% to produce electrical power. Hence, the electrical power can be derived from mechanical power as shown in equation (20). The comparison output of the mechanical power versus electrical power are as shown in figure 9.

$$\text{Electrical Power} = 0.9 \times \text{Mechanical Power} \quad (20)$$

## 5.0 CONCLUSION

From the study, it can be concluded it is possible to induce electricity from self-running magnetic motor.

However, this primarily finding will needs further investigation before a prototype can be developed.

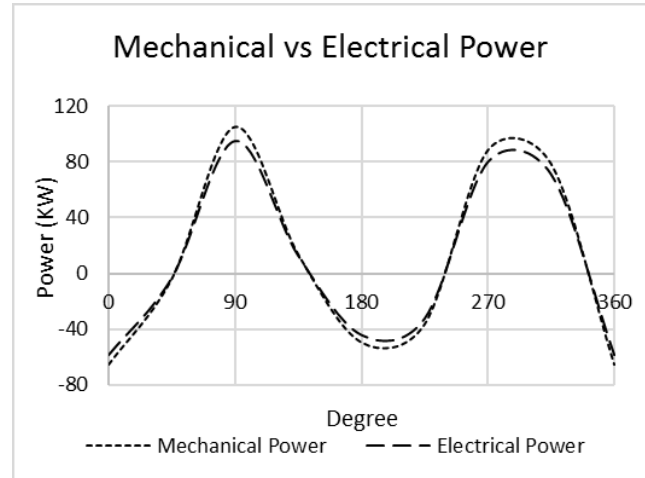


Figure 9: Mechanical power versus Electrical power from self-running magnetic motor

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