

# Mag Mill – A Novel Methodology of Power Generation

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**Abstract**—This project is the implementation of a hybrid configuration of wind mill for power generation purpose. Uses the effects of magnetic repulsion, unique shaped blades have been introduced with magnets attached to it providing an additional force to assist the wind turbines to generate electricity even without the need of wind energy. These wind turbines have advantage over conventional wind turbines because of factors such as contours of the land; often face either inadequate wind or turbulent winds. Moreover it can also be incorporated as a conventional windmill which will operate under sufficient wind energy and when the wind speed falls below the threshold level it can tap into self-revolving and would generate electricity using magnetic attraction and repulsion between the magnets placed on the blades and the electromagnet present on the pole of the wind mill.

**Index Terms**— Wind turbine, magnet, contours, turbulent.

## I. INTRODUCTION

Wind energy has grown quickly in popularity in the United States and around the world in the last 20 years. Wind turbine performance has improved as a result of ongoing research and development and improved manufacturing techniques. More importantly, wind power costs have dropped to the point that they are very near to being competitive with past fossil-fuel generation in terms of cents per kilowatt-hour (kWh). Several big and medium-scale wind power plants with contemporary wind turbines have been erected all over the world with the help of various state legislation and the expanding green power industry. Wind energy will meet 12 percent of the world's electricity demand by 2020, according to EWEA estimates. The total capacity of wind power generators installed has already reached to a large extent of 31138 MW, and the cost of generation per kilowatt-hour has dropped from prior levels. The wind power generator can be connected to the electrical grid and erected. Wind power generators can be operated independently or by integrating alongside with diesel generators and photovoltaic (PV) panels to meet the power shortage in distant areas that are not reachable by large power system networks. In this situation other countries, where fuel is typically expensive and wind authorities are especially advantageous, wind energy can be an appealing alternative. Wind power is primarily generated by converting wind energy into electrical energy by moving the blades of wind turbines in response to airflow. Wind power generation is thought to alter fast in response to wind speed. This allows the car to be more precisely controlled, especially when cornering, parking, or entering a tight space. Wind power, more than any other low-carbon technology, has the potential to reduce emissions significantly by 2050. This is mainly because of the huge scale wind power replacing non-renewable power generation sources by using available sample resources with the highest technological solutions at most efficient resource locations throughout different areas

and benefits by cost reductions, significant end-use electrification of transport and heat applications, shifting energy demand to electricity that can then be supplied by wind (either directly or indirectly, for example power-tracking)

## II. MAGMILL

Using the effects of magnetic repulsion, unique shaped blades have been introduced with magnets attached to it providing an additional force to assist the wind turbines to generate electricity even without the need of wind energy. These wind turbines have advantage over conventional wind turbines because of factors such as contours of the land; often face either inadequate wind or turbulent winds. Moreover, it can also be incorporated as a conventional windmill which will operate under sufficient wind energy and when the wind speed falls below the threshold level it can tap into self-revolving and would generate electricity using magnetic attraction and repulsion between the magnets placed on the blades and the electromagnet present on the pole of the wind mill.

## III. PROPOSED SYSTEM

The proposed system generates power without need of wind energy.

### A. Control Circuitry Block Diagram

The control circuitry consists of MOSFETs (IRF540N), NPN Transistor (BC547), Electromagnet, Resistors, Capacitors, Voltage source and a Hall Effect sensor. This circuit acts as a timing circuit which determines when the electromagnet needs to be turned on and off. It consists of two MOSFET (Q1 and Q2) acting as a switch. The transistor Q2 is driven by the result obtained from the Hall effect sensor H1. Here transistor (BC547) acts as a Not Gate in order to trigger the transistor Q2 because the result obtained from the Hall effect sensor is low.



Figure 1. The transistor Q1 is kept open such that its diode can be used as a freewheeling diode

### B. Main Block Diagram

The project makes use of repulsive force from the magnets oriented to the bottom end of the unique shaped blades and the electromagnet attached to the poles of the windmill. Due to the magnets attached at the bottom of the blades; it needs to be designed in such a way that it provides better stability over centripetal and centrifugal forces. Moreover it can also be incorporated as a conventional windmill which will operate under sufficient wind energy and when the wind speed falls below the threshold level it can tap into self-revolving and would generate electricity using magnetic attraction and repulsion between the magnets placed on the blades and the magnet present on the pole of the wind mill.

1. Magnet
2. Electromagnet with control circuit

### C. Stepper Motor

A stepper motor is a form of Direct Current (DC) motor that do not rotate in a continuous motion. Instead, the one full revolution is bifurcated into many equal number of steps. A stepper motor is made up of several phases, each of which is made up of several coils stacked in groups. The stepper motor revolves by taking single step at a time one after the other, by dispatching energy from the input voltage to each phase in a particular order. A stepper motor converts electrical energy or which can also be referred as a digital input pulse into a mechanical energy, which is the rotation of the shaft in this case.

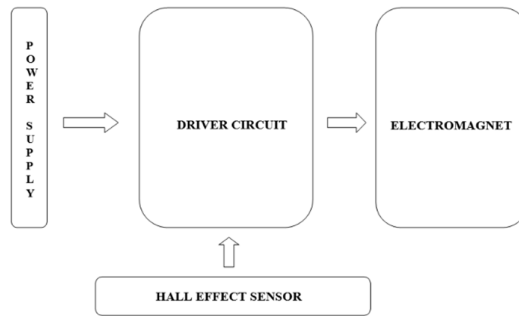


Figure.2

The electromagnetic principle governs the operation of a stepper motor. The rotor is a permanent magnet or soft iron that is encircled by electromagnetic stators. The stator and rotor poles may be teathed. Due to the magnetic effect, when voltage is given to the input terminals, the rotor lines up itself with the stator or moves to a area with the least gap with the stator. The stators are given power in a particular pre-designed order, and the rotor rotates in response to the stator power, therefor resulting in a complete rotation divided into a particular number of steps with a specified step angle.

We can represent it by the block diagram shown below.

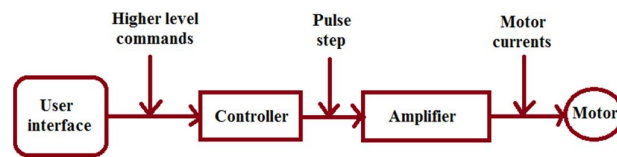


Figure.3

#### D. Specifications

- Step Angle: 1.80 Degree
- Configuration: 4.0 wire bipolar stepper motor
- Holding Torque: 5.50kgcm bipolar mode
- Current/Phase: 1.680 Amp
- Rated Voltage: 2.80Volts
- Inductance /Phase: 2.80mH
- Resistance/phase: 1.650ohm
- Rotor inertia: 68.0 gcm<sup>2</sup>
- Length (L): 48.0mm
- Shaft Length : 16.0 mm
- Weight: 360.0 grams
- Width: 42.30 mm

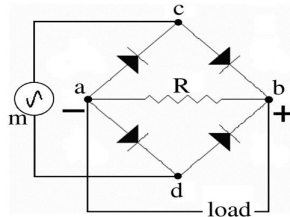


Figure.4

#### E. Stepper Motor As Generator

Stepper motors are everywhere! They come in different varieties of configurations and number of poles .Any electric motor that is independently spinning will give out an output voltage. Stepper motors are highly efficient,

because they consists of many number of poles to cross each other thereby resulting in the generation of electrical pulses. These pulses generally are alternating current(AC) voltage that may be used for directly operating the LEDs. By combining simple full bridge rectifiers, the AC voltage can be rectified and transformed to a DC voltage.



#### F. Neodymium Magnets

Neodymium magnets are one of the strongest permanent magnets across the globe. They fall under the Rare Earth magnet family. Because they are primarily made up of components like Neodymium (Nd), Iron (Fe), and Boron (B), they are also popularly referred to as NdFeB magnets, or just NIB (B). These Magnets are made up of neodymium, iron, and boron are called as neodymium magnets. The iron in the magnet will corrode if it is left exposed to the elements. Coating the magnet is generally preferred to strengthen the brittle magnet material and prevent it from corrosion. Coatings are available in a range of materials, although nickel is the most prevalent and favoured metal. Unlike most other types of magnets, rare earth magnets have a great resistance to demagnetization. They will not lose their magnetic capacity if they come into contact with other magnets or if they are dropped. They will lose their magnetising strength if they are heated above their maximum rated temperature that is 176°F (80°C) for ordinary N grades and if the temperature exceeds the curie temperature that is 590 (310°C) the magnet will lose its magnetizing property permanently.



Figure.6

| Material | Br    |        | Hcb (Hc) |        | Hcj (Hci) |        | (BH)max |      |
|----------|-------|--------|----------|--------|-----------|--------|---------|------|
|          | mT    | G      | kA/m     | Oe     | kA/m      | mT     | G       | kA/m |
| N27      | 1,030 | 10,300 | 796      | 10,000 | 955       | 12,000 | 119     | 25   |
| N30      | 1,080 | 10,800 | 796      | 10,000 | 955       | 12,000 | 223     | 28   |
| N33      | 1,130 | 11,300 | 836      | 10,500 | 955       | 12,000 | 247     | 31   |
| N35      | 1,170 | 11,700 | 868      | 10,900 | 955       | 12,000 | 263     | 33   |

Figure.7

#### G. Advantages of Neodymium Magnets

- The Power to weight ratio is best when compared to other magnets
- High resistance against demagnetization.
- Cost-effective choice

#### H. Hall Effect Sensor

Hall Effect Sensors are electrical gadgets that gets excited when an external magnetic field present nearby. Polarity which are North and South Poles and flux density are two key factors of a magnetic field (B). When the gadget is placed under the influence of an external magnetic field, the magnetic flux line put a force on the semiconductor material, pushing the electrons and holes that are the charge carriers to the opposite end of the

semiconductor slab. As these electrons and holes move across, a potential difference is generated in-between the two ends of the semiconductor material. The path of electrons in the semiconductor material is altered by an external magnetic field that is at right angles to it, with the effect being larger in a flat rectangular material. The Hall Effect is the result of employing a magnetic field to produce a quantifiable voltage.

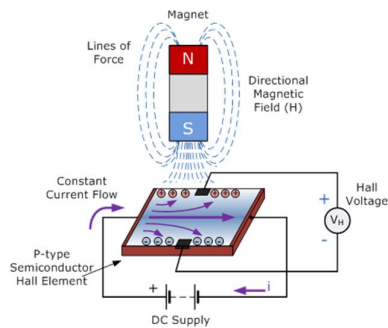


Figure.8

### I. A3144 Hall Effect Sensor

Pin Configuration:

| No: | Pin Name               | Description                                                                           |
|-----|------------------------|---------------------------------------------------------------------------------------|
| 1   | +5V (V <sub>CC</sub> ) | Used to power the hall sensor, typically +5V is used                                  |
| 2   | Ground                 | Connect to the ground of the circuit                                                  |
| 3   | Output                 | This pin goes high, if magnet detected. Output voltage is equal to Operating voltage. |

### J. Specifications

- Digital Output :Hall-effect sensor
- Running voltage: 4.50 Volts to 28.0 Volts(typically 5V)
- Output Current: 25.0mA
- All the two poles of the magnet can be detected
- The Operating voltage is equal to Output voltage
- Rated range of temperature: -40°C to 85°C
- Switching on and off time is 2μs respectively
- Inbuilt protection towards reversed polarity
- Used for industrial and automation Applications

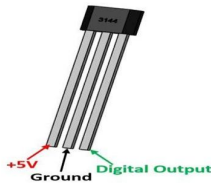


Figure.9 A3144 Hall Effect Sensor

### K. Control Circuit

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transistor Q2 is driven by the result obtained from the Hall Effect sensor H1. Here the transistor (BC547) acts as a Not Gate in order to trigger the transistor Q2 because the results obtained from the Hall Effect sensor is low. The transistor Q1 is kept open such that its diode can be used as a freewheeling diode.

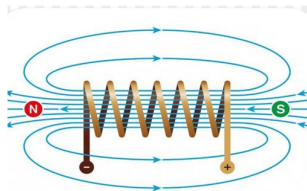


Figure.10

#### L .Electromagnet

An electromagnet is a magnet that uses electricity to work. Compared to a permanent magnet, the magnetising ability of an electromagnet can be easily altered by changing the amount of electric current flowing through it. By reversing the direction of the flow of current the poles of the electromagnet can be reversed.

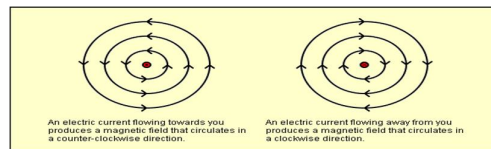


Figure.11

The operation of an electromagnet is based on the fact that a flowing electric current produces a magnetic field, which is circular in shape around the electric current, as illustrated in the diagram below

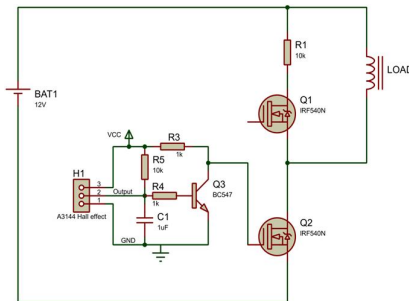


Figure.12

#### M. Battery

The battery is an energy storage device built up of single or multiple electrochemical cells that are connected externally which can be used to supply power to electrical devices, which varies from smaller applications like cellphones, flashlights, to larger applications like electric cars. When a battery is connected to an external load, electrons move from the anode which is the negative terminal, to the positive terminal, which is the cathode, through an electric circuit or an external load. A redox reaction take place when a battery is connected to an external electric load, Which converts high-energy reactants to low-energy resultant products, and the change in free energy is fed as an electrical energy to the external circuit.



Figure.13

#### N. Connecting Wires

A wire is a flexible metal string that is commonly used to carry mechanical loads, as well as electricity and telecommunications messages. Stretching extremely ductile elements/metals by passing across a small hole in a draw or die plate is a most frequent method to make wire. Wire gauges are calibrated in gauge numbers and found in a different range of sizes.



Figure.14

#### O. Building Material

Poly vinyl chloride (PVC), a resultant product (synthetic resin) made from polymerization of vinyl chloride. Next to polyethylene, it is the second most in production and consumption, PVC is commonly used in domestic products like shower curtains, raincoats and industrial products like window frames and vent pipes.



### IV. ADVANTAGES

1. Cost Effective: The proposed system is cost effective in terms of output power to weight ratio.
2. Easy Maintenance: As it consist of few moving parts when compared to conventional windmills, so it is easier to maintain.
3. Generates Electricity without the need of Wind: This wind turbine has a capability to harvest energy without the need of wind. This could solely improve the efficiency of the turbine.
4. Altitude Independent: As the system does work without the need of wind energy, thereby eliminating the dependency of altitude.
5. Constant frequency: The major problem in renewable energy sources is the possibility of synchronizing to the power grid. As frequency needs to constant while synchronizing, so there is in need of frequency converter. This can be eliminated by using Magmill, as it has the capability to maintain constant rotational speed with respect to load.
6. Controlling: Controlling the Magmill is even easier, as there aren't any complex circuit to deal with.

### V. DISADVANTAGES

1. As the proposed system consist of magnets attached to the blades, the blades are to be designed in such a way to withstand the weight of the magnets and there's a chance of magnets deteriorate over a period due to weather.
2. Magnetic shielding has to be implemented.
3. The usage of Magnets and Electromagnets heavily influences the cost of the system.

### VI. CONCLUSION

Thus, the MAG MILL is capable of generating power on its own without the need of wind but by giving it input and gaining an increased output. Even though it's a profitable way to gain electrical power a lot of derivatives and determinant factors are to be considered for it to be able to produce more power than it had consumed to operate. If all the factors work in favor it is possible to generate more power than which is used by the generator. But it is a much costlier way to produce electricity as it involves complex steps from input to output and the reliance on magnets and electromagnets.

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