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Solar Powered BLDC Portable Fan

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Abstract: *In the present time solar energy is at its booming stage compared to other sources, As it's the perfect alternative for all conventional sources required for electrical energy generation. This paper proposes a solar-powered BLDC Fan that is portable. A BLDC motor is a brushless DC motor which is like a synchronous electric Motor powered by direct-current (DC) electricity and it requires electronic commutation technique rather than a mechanical commutator because no brushes are used. Electronic commutation and speed control is done by using MOSFETs and Hall effect sensors. In BLDC motors, there are linear relationships between current to torque and voltage to rpm. Because of this linearity bldc portable Fans get an excellent opportunity to use the BLDC. This paper presents practical implementation of such a bldc motor for fan application along with the Solar powered facility and Portability, actual power measurements in comparison with conventional fans. Complete Electrical and the associated advantages and Applications of this solar powered BLDC portable fans are also presented.*

Keywords: BLDC Motor, Portable fans, electronic commutation, energy consumption, MPPT, MOSFETs, Arduino etc.

I. INTRODUCTION

In India electrical energy is mostly generated by coal but this fossil fuel is not going to be available in future. So there is much need to find another alternative for coal AND that alternative is solar energy, which can be easily available by sunlight. In residential sector, maximum Electrical energy can be saved from BLDC Fans or By replacing other appliances where normal AC induction motors and DC brushed motors are used whereas the other sectors are so commercialized that there is need to propose and sustain major conservation of energy through other alternate energy efficient appliances in these sectors. ceiling fans & table fans are sold more than 30 million units per year with an installed base of more than 250 million units in India. Further when the residential consumption was analyzed, it was found that the total consumption of power by fans amounted to 6% which is more than that of the TV + Fridge combined.

This paper describes usage of Brushless DC Motor in solar powered portable fan in order to reduce the power consumption by more than 50% without sacrificing on the performance or any other features. With the rapidly decreasing cost of solar pv systems, it is expected that solar power would be useful in small and large scale applications in domestic well as industrial sectors. Solar would be a viable option with some concessions to provide electricity in remote areas. however these areas typically have no grid. Next, in not-so-far-off areas also where grid connections are easily available, there are outages and brown out conditions. Utilization of battery may help to solve these problems, but this requires additional higher cost. Therefore off-grid operation, without the use of batteries would be an attractive proposal for solar PV in simple low-cost applications like fans. In this project, development and analysis of solar powered fans in different configurations are presented. Pedestal Fans are used in almost all houses in the India that can be considered as a test case after converting it into a BLDC motor based portable fan.

The results from practical studies show that [1] that the use of a BLDC motor in place of an AC motor cuts down power consumption to about 50 W from 150 W. This is only about 33.3 % power consumption with an AC motor. In another study [2], it has been demonstrated that 40W power is consumed by an external rotor type BLDC motor driven fan, whereas 70 W power is consumed by an induction motor driven fan. In normal BLDC drives, PWM technique is used to control the speed by controlling the voltage applied to the motor and How speed controller works in various PWM switching modes is

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studied in [3]. Since, PWM technique is used to both upper and lower leg switches of the MOTs driver circuit to make it more sharp and robust, this method is used in this work.

Nowadays, growing energy needs and increasing environmental concern, alternatives to the list of non-renewable fuels have to be investigated. One such alternative is solar energy. There is zero bad effect of solar energy environment, this is advantage of solar energy, solar energy can be used in those areas where extension of the electricity power grid is very expensive, and solar energy is unlimited.

By using solar energy as a source, we drive a fan in which a BLDC motor is implemented. This type of fan consumes generally half of the power than conventional fans. The other advantage of this fan is that it is able to run in those areas where no electricity is supplied.

II. Problem Statement

All types of Ac and dc motors are being replaced by BLDC motors due to various advantages such as high efficiency And low noise features which are more desirable for consumers.

One disadvantage of BLDC motors regarding the variable speed operation is now overcome by some research and bldc motors can be run at constant speed. This allows BLDC motors to be used in applications like Fans where constant speed with varying load is required.

Since BLDC motors are a little bit more expensive than the conventional DC motors and Induction motors.
So, our main approach in our portable Fans is to reduce BLDC motor and control system's cost and to make our portable fan cheaper.

To control and run the BLDC motor, sensored or sensorless techniques are used, sensorless techniques Require a complex algorithm which is not always easy to implement. So we used a sensored technique to control and run our bldc motor in which Hall-effect sensors are used.

III. Objective

1. Main objective of the research paper is to make solar powered BLDC based portable Fan.
2. Design of PV based BLDC Motor system
3. To minimize power Loss.
4. To use MPPT and dc to dc boost converter for maximizing the voltage at each step.
5. To compare traditional Fan with novel noise less BLDC Fan.

IV. Methodology

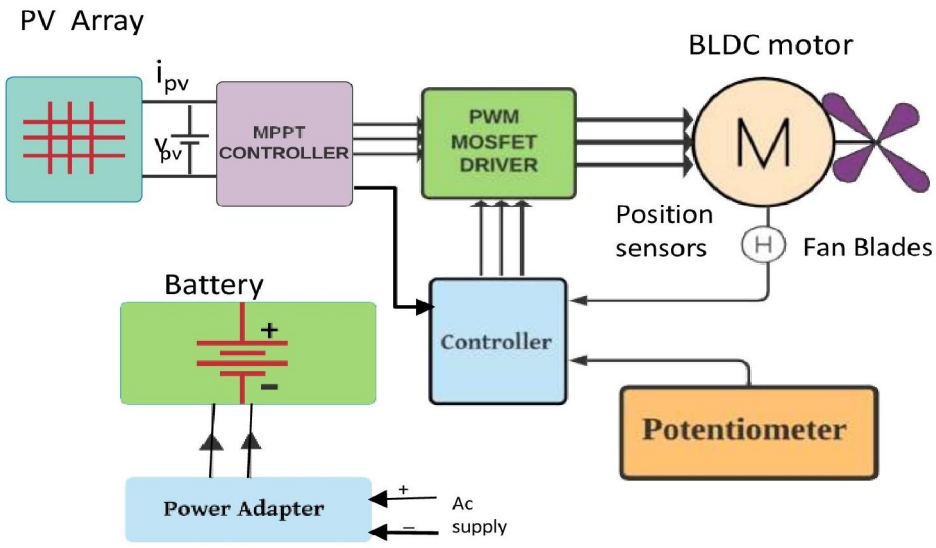

Figure 1: Block Diagram

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V. WORKING

The working principle of brushless DC motor and brushed DC motor is same and That is whenever a current carrying conductor is placed in a magnetic field it experiences a force. Due to that force the magnet will experience an equal and opposite force and in result the motor is run. In the brushless DC motor, the current carrying conductors are stationary whereas the permanent magnets are moving.

When the stationary armature windings get power supply from a DC source, those become an electromagnet and start generating the uniform magnetic fluxes in the air gap. Even though the source of supply is DC, switching devices such as MOSFETS, IGBTs make an AC voltage waveform with trapezoidal shape. Due to the force of interaction between electromagnets stator and the rotor in which permanent magnets are placed, the rotor continues to rotate. With the switching of windings as High and Low signals, corresponding winding energized as North and South poles. The permanent magnet rotor with North and South poles situates with stator poles which causes the motor to rotate.

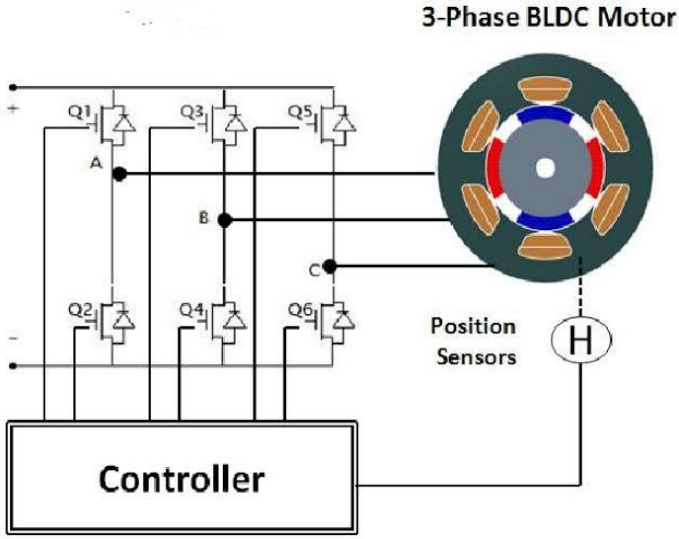

Figure 2: Controller and MOSFET'S driver Circuit

Controller controls the brushless motor movement or speed by activating the appropriate MOSFETs to create the rotating magnetic field so that the motor rotates.

There are some common methods used for determining the rotor position. The first common method is by using Hall-effect sensors embedded in the stator, arranged equally 120 or 60 degrees from each other. Due to rotation of permanent magnets rotor the hall effect sensors those are placed upon permanent magnets will sense to the magnetic field and it will generate a logic "positive" for one magnetic pole or logic "negative" for the opposite pole. According to this information the Arduino Controller knows when to activate the next commutation sequence or interval.

V. CODE DESCRIPTION

```
#include <Liquid Crystal.h>
#include <stdio.h>
#include <Servo.h>
Servo esc;
Liquid Crystal lcd(6, 7, 5, 4, 3, 2);
int buzzer    = 13;
void setup() {
Serial.begin(9600);//serial Event();
  esc.attach(8);
 esc. write Microseconds(1000);
 pin Mode (buzzer, OUTPUT);
```

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```
digitalWrite(buzzer, HIGH);
lcd.begin(16, 2);lcd.cursor();
//lcd.print("Smart BLDC Fan");
lcd. print("    BLDC Motor  ");
lcd. Set Cursor(0,1);
lcd. print("  Speed Control ");
 delay(1500);
   }
    void loop(){
     int val;
      val = analogRead(A0);
      val = map(val, 0, 1023,1000,2000);
       esc.writeMicroseconds(val);
}
```

VI. COMPONENTS AND RATINGS

Sr. No	COMPONENTS	SPECIFICATION & RATINGS
1	Solar panel	30 watt
2	BLDC motor	2200 kv
3	MPPT	Regulated and unregulated 12 Volt Dc
4	Adapter	12 volt , 2 Ampere
5	Battery	12 volt. 1.3 Ah
6	LCD display	16×2 , 5 volt
7	Arduino UNO	828p , 12 volt
8	Devolvement Board	12 volt Dc
9	Speed Regulator	12 volt DC
10	MOSFETs	12 volt , 40.volt breakdown voltage
11	Others	

VII. CALCULATIONS

SOLAR PANEL = 30 WATT = 12 V × I

So, I = 2.5 A

SPEED IN (RPM) CALCULATION:

SPEED = **KV** RATING OF MOTOR × APPLIED VOLTAGE

BATTERY BACK UP TIME:

TOTAL BATTERY POWER = INPUT VOLTAGE × CURRENT

= 12 V × 1.3 **A**

= 15.6 WATT

BATTERY BACK UP TIME = BATTERY POWER / LOAD

AT SPEED (3),

I = 1 A

V = 4.8 V

POWER = V * I

= 1 * 4.8 = 4.8 WATT

TOTAL LOAD = **4.8** WATT

BATTERY BACK UP TIME = 15.6/4.8

= 3.25 hours

At speed 3, bloc portable fan run 3 hours at battery fully charged.

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VIII. HARDWARE

Figure 3: Hardware

IX. APPLICATIONS AND ADVANTAGES

1. It reduces the problem of scarcity of power supply.
2. As energy consumption rate is very less and almost half as compare to normal Fans so longer backup on solar energy
3. Can be used in busses and trains
4. Applicable at border areas and where no electricity is Available. And very easy to carry because of the light weight.
5. It can be used in mediation centers and research centers where silence is first priority because of absence of brushes noise is very less.

X. CONCLUSION

In this paper the study and implementation the bldc motor and it run successfully. Solar powered bldc fan is as doing made portable and easy to carry so can be used at border areas or where no electricity is available as well as it can be placed in cars and busses as well as an adapter is used in addition to solar panel to run the BLDC Fan in case of power failure.

BLDC motor-based fan solution will provide an insight into the present status. The scarcity of Electrical energy is one of the major problems that we are facing today and will face in future. We can save energy by using energy efficient Fans. Energy efficient fan is such a measure which has a greater role in reducing the power consumption and hence we have a BLDC portable fan.

FUTURE SCOPE

This section presents the possible future directions to extend the presented work.

1. In future the experimentations can be carried out by using the greater number of attributes
2. We can add some additional electronic devices to make project smooth and unique
3. We can add SLEEP MODE that would reduce its speed automatically after provided set hours.
4. LED indicator
5. Timer
6. Light
7. Hand claps sensor

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