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COST EFFECTIVE SMART CEILING FAN

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Abstract *–*

A brushless DC (BLDC) motor is a synchronous electric Motor powered by direct-current (DC) electricity and having an electronic commutation system, rather than a mechanical commutator and brushes. In BLDC motors, current to torque and voltage to rpm are linear relationships. This linearity provides an excellent opportunity to use the BLDC motor in the conventional ceiling fans. This paper presents practical implementation of such BLDC motor for ceiling fan application along with the actual power measurements in comparison with conventional ceiling fans. Complete electronics and the associated advantages and disadvantages of this BLDC ceiling fans are also presented.[1]

Keywords - *BLDC Motor, Ceiling fan, Energy Consumption, Stator, Rotor, AC, DC*

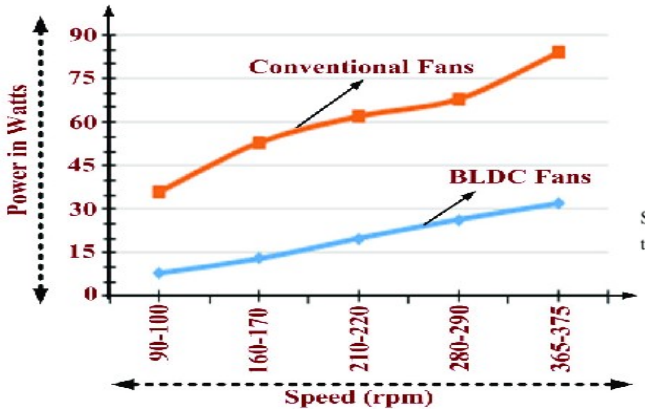

Fig 1. Power Consumption Chart

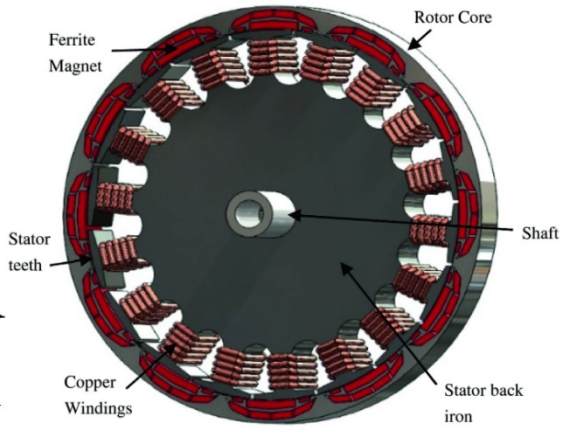

Fig 2. Parts of BLDC Motor

Introduction - Brushless DC Motors or BLDC Motors have become a significant contributor of the modern drive technology. Their rapid gain in popularity has seen an increasing range of applications in the fields of Consumer Appliances, Automotive Industry, Industrial Automation, Chemical, Medical, Aerospace and Instrumentation. When it comes to saving energy, most of us generally overlook ceiling fans.

It seems big appliances like air conditioners or heaters with suspicion for surreptitiously piling up the electricity bill. It is fail to understand though is that the ceiling fans are all-weather appliance which keeps running all through the day (and even night) thus cumulatively consume more electricity than assume it to be.

For years, ceiling fans used to come with the same hardware of induction motor which typically consumed **70-80 watts** for a standard ceiling fan. But in the last few years, A new technology called **BLDC** is being used to make fans consume a lesser amount of energy, without compromising much on the air delivery. **BLDC** stands for **brush-less direct-current motor**, a special type of motor which has permanent magnet instead of electromagnets found in a conventional induction motor. BLDC motor has important advantages over induction motor like low electricity consumption, lesser noise generation and better lifespan.

Main Parts of BLDC Fan

BLDC Drive: In BLDC drive following main component is use.

SMPS: SMPS is use to convert ac supply into dc supply.

Microcontroller : Microcontroller is use for receiving the input data from remote control and give output data accordingly to inverter.

Inverter:

BLDC fan power flow chart helps to understand the working of process. when fan is turned on the SMPS convert AC supply to DC supply then DC supply is given to the microcontroller and it also receives the input signal from the remote control and accordingly output signal of the microcontroller sends the signal to the inverter, then inverter drives the BLDC Motor.[2]

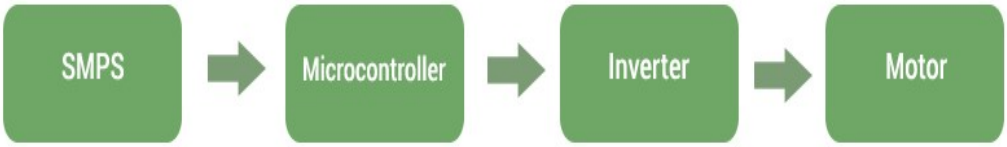

Fig 3. Power Flow Chart

Fig 4. BLDC Driver

BLDC Motor:

Rotor : In BLDC ceiling fan permanent magnet use in the rotor.

Stator: Copper winding use in stator which produces magnetic flux after supply of electricity.

Fig 5. BLDC Stator

Fig 6. BLDC Permanent Magnet

Super-Efficient Equipment Program (SEEP) and The Rise of BLDC Fans

Bureau of Energy Efficiency (BEE) is the government agency that promotes, develops and monitors various programs for improving energy efficiency. They are the ones who give energy star ratings which you typically see on electronic appliances like ACs, refrigerators, washing machines etc. BEE has started a program called **Super-Efficient Equipment Program (SEEP)** in February 2012 with the intent to rate appliance on its energy consumption parameter and promote energy-efficient consumer appliances. Ceiling fans were the first target of this program. Since the launch of this program, many startups have come with the idea of 'BLDC fans' which are usually 5-star rated and thus are highly energy efficient.[3]

Feature	BLDC Fan	Normal Fan
Energy efficient	Yes	No
Electricity	Direct current	Alternating current
Wear and tear	Low	High
Long life	Yes	No

Fig 7. Comparison between BLDC Fan vs Normal Fan

Advantages of BLDC Motor over Induction Motor

Prominent advantages of BLDC motor over induction motor is summarized as

- Lower Electricity Consumption (65% savings)
- Longer backup on Inverters (even on Solar)
- Improved reliability
- Noise reduction
- Longer lifetime

Disadvantage of BLDC fans

There are not so many but indeed have some disadvantages for BLDC fans.

- Expensive
- The more online marketing approach
- Complex wiring and installation
- The extra cost of batteries

Energy Consumption: Ordinary Fans Vs BLDC Fans

Now let us mathematically calculate how much electricity would be consumed, how much money would be saved using BLDC technology and how long it would take to recover the price of a BLDC fan through the energy-saving it gives over time.

The typical induction-based fan would consume around 75 watts whereas a BLDC fan would consume about 30 watts. Unlike lights which are only used during nights, a fan is an appliance which runs most of the time if the ambient temperature is high with no regular airflow of cool air. So, assuming they run regularly for 15 hours for 365 days calculation would be:

	Wattage	**Hourly Electricity Consumption**	**Daily Electricity Consumption**	**Yearly Electricity Consumption**	**Yearly Costs (assuming Rs 6 per unit)**
Regular Fan	75 Watts	0.075 units	1.125 units	410.625 units	Rs. 2463.75
BLDC Fan	30 Watts	0.03 units	0.45 units	164.25 units	Rs. 985.5

Typical price per unit of electricity in India is assumed to be around 6 INR. for residential users. Though the pricing per unit varies greatly between regions, power companies, slab it is in, and whether the usage is commercial or residential. For metros, it is better to assume tariffs around 10 Rs/unit but for India as a whole 6 Rs is more practical.

Features –

Energy Saving

Control by Remote area's

Remote Control

Control With Phone

Control with Google assistant

Control with alexa eco dot

Operate Both supply, Ac/Dc

CONCLUSIONS - BLDC motor based ceiling fan solution will provide an insight into the present status as well as into various challenges faced in deriving the solution along with some of the basic fundamentals of the DC, BLDC and AC motors in general. This project provides an overview of the various building blocks of the solution and identifies the right technology-approach to be adopted for energy utilization. Energy crisis is one of the major problems that we are facing today. We can save energy by using energy efficient appliances. Energy efficient fan is such a measure which has greater role in reducing the power consumption and hence we have a BLDC fan. It is highly compatible, highly efficient, less noisy, reliable, longer life-time and have a linear torque – speed characteristics. All these features together contribute to energy saving up to 40-50 %.[4]

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