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Construction of a 12V Standalone Solar Powered DC fan for Solar Energy Utilization

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Abstract

This project was embarked on construction of a 12 volts standalone solar powered DC fan for solar energy utilization using constructed DC fan, solar photovoltaic panel illuminated by solar radiation, 12 volts DC battery and connectors. After construction of DC fan, measurements were carried out using 25 volts adjustable DC regulated power supply system to feed in variable voltage and determine the output voltage and the speed of fan at different distance using hand held anemometer. The rate of blowing air of air determined at different input voltage and distance determines its performance ability. Therefore, the performance ability of DC fan determined upholds its utilization at home and office, both in urban and rural areas where grid electricity is not regular or unavailable.

Keywords: Solar Energy Utilization; Drect Current; Photovoltaic; Grid Electricity; Home appliances.

1. Introduction

Diminishing in fossil fuel due to over-dependence has becomes imperative to employ the use of other energy sources capable of substituting the diminished fossil fuel which pollute and degrade natural resources (1). Generally, this contributes significantly to addressing the current challenges in Nigerians energy systems. Therefore, home or office appliances capable of working with solar energy system would continuously produce.

Furthermore, the most abundant inexhaustible, non- polluting and free energy resources used economically to supply people's increasing energy demand currently is solar energy. (2). Solar energy is radiant light and heat from the sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics', solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis. One of the most exciting developments in the renewable energy sector in recent years has been the decline in the cost of photovoltaic (PV) cells. The decline in price will continue with increasing in numbers of manufacturers and solar energy researcher/utility due to its efficiency and renewable in power supply (3).

With the reliable and continuous solar energy power supply, most day – to- day useful appliances such as fans, water, TV, Radio, pumping machine among other can be powered by means of solar energy. Actually, solar DC powered fan is more convenient compared to other types, like kitchen exhaust, window, and pedestal fans because of its portability. Hence this project work titled "construct a 12V DC solar powered fan for solar energy utilization in both urban and rural areas where grid electricity is not regular or unavailable".

There are two primary types of fans, namely; centrifugal and axial fan (4). The standing fan under consideration is an axial type meant to be powered with a DC source from a solar panel with a 12V battery backup. A typical fan system consists of a fan, an electric motor, a drive system, duct or piping and flow control devices.

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Fan design is a compromise between the various fan parameters that affect fan efficiency. The velocity is directly proportional to the fan speed; the pressure is proportional to the square of the fan speed; and the power required is proportional to the cube of the fan speed (5). A solar standing fan is a mechanical fan powered by solar panels. The solar panels are either mounted on the device or are installed independently. Solar fans mostly do not require secondary power sources other than solar power, as most of them are used for cooling purposes during day time. Some types are also used for heating purposes. It runs the fastest when it is the hottest outside providing savings on air conditioning costs (6).

2. Material and methods

2.1. Materials/Components,

The major materials/ components of the Solar Powered Standing Fan consist of the following:

- Solar Photovoltaic panel (12V, 100 watt)
- Solar charger controller (12V/10A)
- Electric motor
- Blade case (4.9mm long)
- Fan regulator (12V)
- Fan blade (1.6m)
- Control unit
- Fan base (metal of 2.7m long)
- Battery (12V)
- 25V DC Regulated Power Supply
- 1.5mm coaxial cable
- Anemometer (m/s)
- Meter rule (1m)

2.2. Prototype Design

The prototype and major components require for solar power DC fan are as shown in Figure 3.1 below.

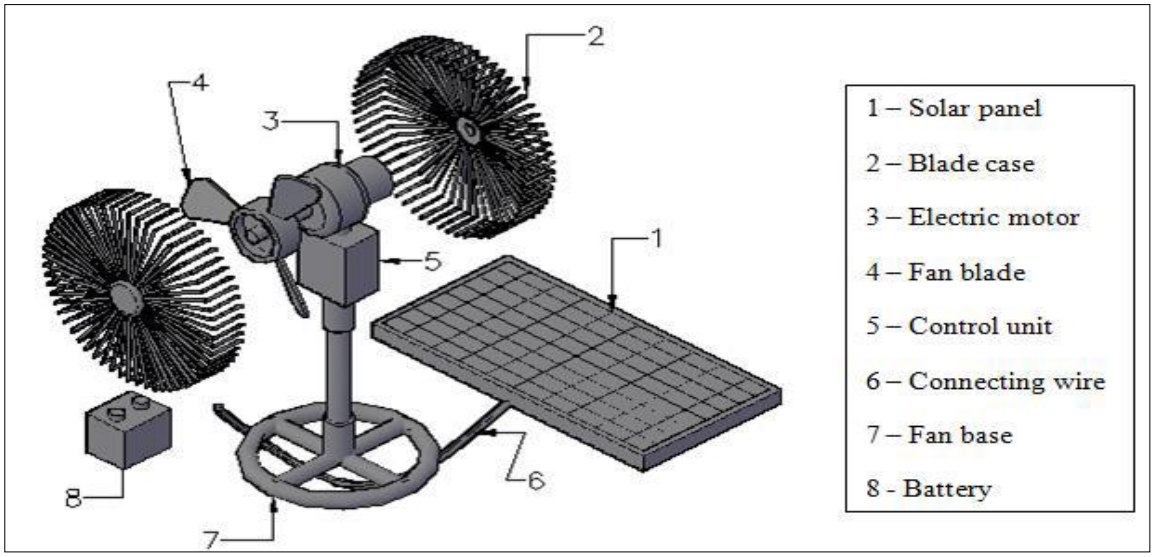

Figure 1 Prototype Design of Solar Power DC Fan (1).

2.3. Amalgamation of Components

The Solar panel, battery, DC Motor, fan blade, fan stand, covering sheet and the remaining components used were locally sourced. The DC motor was mounted on the fan stand and it was connected to the fan blade. The 12V DC battery was connected to the DC motor. The charging of the battery was done when the solar panel connected through solar charger controller and the battery, the solar charge controller regulates the charging voltage and the rate at which electric charges is added to or drawn from battery (which prevent the battery from overcharging and discharging). So, the 12V

DC battery can be used for the fan anytime of the day. A voltage regulator (control or switch) is then connected to the fan to act as saturation "Switch ON" and cut off "Switch OFF".

2.4. Testing for the Continuity

Point to point test was carried out on the connecting cables (1.5mm cable), battery, DC motor, Solar charge Controller and the solar panel to avoid Open or short circuit. This was easily achieved using multi-meter.

2.5. Experimentation

Experimentally, performance of the constructed 12V DC fan was evaluated using 25 volts Adjustable DC Regulated Power Supply. This is done to determine output voltage and current at different input voltages. The Regulated Power Supply was set to 1V (input voltage) and the DC fan was connected to it (positive and negative of the DC fan to the Positive and Negative of the Regulated Power supply). The output voltage and current were measured and recorded. This step was repeated for several value of voltage such as; 2V, 3V, 4V, 5V……25V of the input voltage and the corresponding value of voltage and current were measured and recorded.

The speed of the Fan was measured at different distance using Hand Held Anemometer (by setting it to m/s) from the threshold voltage (minimum working voltage required). The speed was determined at each measurement voltage and at different distance (e.g. 0.1m, 0.2m, 0.3m……..1.0m). These were also measured and recorded.

2.6. Market Value

A market value survey was carried out to compare the constructed 12V standalone DC fan with the already made available in the market. This evaluates the economic importance of the constructed DC fan.

2.7. Working Durations

In comparisons with and without built 12V DC fan controller, the constructed standalone fan was tested with 12V, 7.2Ah Panasonic Deep Cycle battery and its running time was observed and noted. This determines how necessary the inclusion of fan controller.

3. Result

The result of this work undertaken at Physics Electronics Workshop, Science Laboratory Technological Department, Federal Polytechnic Offa are as shown below. Table 3.1 present the results of output rate of blowing air of the air at different Distance and Voltage Supply to DC Fan.

Table 1 Rate of Blowing Air of the Air at different Distance and Voltage Supply

		Speed(m/s)				
S/N	Distance(m)	2V	3V	4V	5V	6V
1	0.1	0.50	0.60	0.80	1.20	1.40
2	0.2	0.40	0.50	0.70	0.80	1.30
3	0.3	0.00	0.40	0.60	0.70	1.20
4	0.4	0.00	0.40	0.60	0.60	1.10
5	0.5	0.00	0.00	0.60	0.50	0.90
6	0.6	0.00	0.00	0.40	0.50	0.90
7	0.7	0.00	0.00	0.40	0.50	0.70
8	0.8	0.00	0.00	0.00	0.50	0.60
9	0.9	0.00	0.00	0.00	0.00	0.50
10	1.O	0.00	0.00	0.00	0.00	0.40

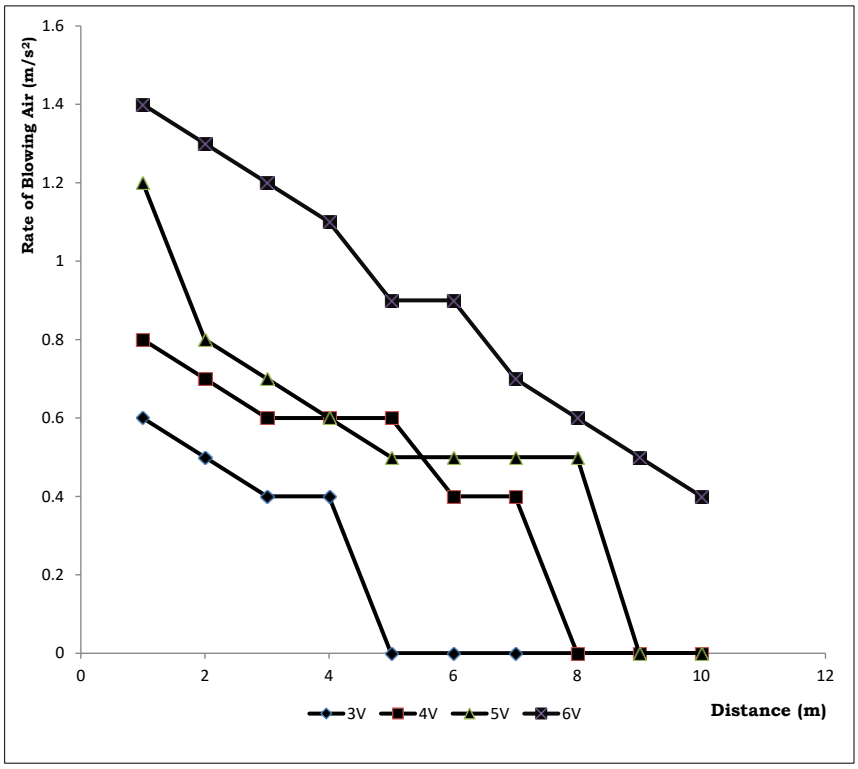

Figure 1 Variation of Rate of Blowing Air against Distance

Figure 3.1 above shows the variation of the rate of blowing air of the air against distance at different input voltage intervals for the experiment.

4. Discussion of Results

With the experiment carried out on the constructed 12V DC fan using 25 volts Adjustable DC Regulated Power Supply. The results of rate of blowing air of air measured at different distance and different input voltage.

Figure 3.1 shows the variation of rotational speed for the rate of blowing air of the air observed against distance at different input voltage. Increase in the input voltage leads to increase in the rotational speed for rate of blowing air of the air; this causes the fan to blow faster and covered a long distance. As showed in table 3.1 and figure 4.1, the speed at 6V covered 1m and more of distance.

When compared the market value with the constructed 12V standalone DC fan and already made available in the market. The constructed one cost less with the cost involved within #7000 to #10,000 while, the already made cost within #25,000 to #35,000.

5. Conclusion

The construction of 12 DC Solar Powered Fan has been done using solar photovoltaic panel, solar charge controller, DC motor, fan regulator etc. was necessitated by the need to have a DC fan that could be powered with a renewable energy source. A 12V DC battery was included as a source of power backup for use when there is no sunlight-in the night.

To achieve a minimum consumption of power, the fan was made not to oscillate but rather was made to be manually tilted up and down to change its orientation if necessary. As a result, the design was expected to be relatively noiseless and energy efficient. However, the rotational speed of rate of blowing air of the air observed shows that, increase in input voltage leads to increase in the rate of blowing air of the air of the DC fan and make the fan to blow faster and covered a long distance.

Recommendations

The use of solar energy as a means of generating power been the source of power for the constructed DC fan is much more economical than hydroelectricity and the use of generators. In view of this, I therefore recommends that government should encourage the use of solar energy as Nigeria has vast supply of solar radiation reaching it. Also, the materials should be made available in the market and accessible to individuals in a cheaper rate.

Compliance with ethical standards

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Disclosure of Conflict of interest

No conflicts of interest in the publication.

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