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Review on Vertical Axis Wind Turbine

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ABSTRACT: Wind power is one of the most promising renewable energy resources for electricity generation, and has seen a rapid increase in its acceptance since 2000. The most accepted classification for wind turbines is by their axis of orientation: horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAWT). HAWTs are used for medium to large scale power projects in many countries, and most commercial establishments around the world are based solely on these turbines. On the other hand, HAWT has not been recognized as a viable option for harnessing wind energy in urban areas, where the wind is less intense, much more chaotic and turbulent. VAWT has been suggested as a better option for cities and isolated semi-urban areas. Several characteristics have been suggested for large-scale deployment of VAWTs, for example, good performance under weak and unstable wind, no noise and safety concerns, and aesthetically sound for integration into urban areas. Significant research has been published on wind turbine technology and resource assessment methodologies, and this review paper is a modest attempt to highlight some of the key developments in VAWT, with a focus on integration with urban infrastructure. Based on state-of-the-art knowledge on the subject, several recommendations have been made for future study and acceptance of wind turbines in urban areas. It was concluded that further research is important in making VAWT a viable, reliable and affordable power generation technology for many reduced and decentralized power applications.

KEYWORDS: Wind energy, Vertical axis wind turbine ,Blade aerodynamics ,Power coefficient ,Field performance ,Commercial development

I.INTRODUCTION

Renewable energy is currently the most important topic in the world. It was recognized that fossil fuels
The reserves in the world are rapidly depleting and no reserves have been identified. In addition to Energy Production from fossil fuels can cause many environmental problems such as emission of greenhouse gases, Global warming and acid rain. Renewable energy sources play a major role in such a situation.
Renewable energy is energy that is obtained from renewable sources such as wind, sunlight, rain, tide, etc.

Waves, geothermal heat…etc. Generally renewable energy provides energy for four different sectors. they are power generation, air and water heating/cooling, transportation, and rural (off-grid) energy services. [1] as An example, Iceland and Norway already generate their electricity using renewable energy. a lot of
Countries have set a goal of reaching 100% renewable energy in the future. For example, the government of Denmark has decided to switch to 100% of its total energy supply (electricity, mobility and heating/cooling) renewable energy by 2050. [2]
Wind energy has been identified as a promising renewable option. Many countries in the world have recognized And they have put in place policies to ensure that wind power has an increasing role in energy resources.
1.1. Air Winds are generated due to the difference in the pressure of the atmosphere. due to atmospheric pressure The difference is that the air particles move from the high pressure end towards the low pressure end. While blowing air, the air molecules Everything except the equator is subject to the Coriolis effect. winds are often referred to according to
The direction from which the wind blows and its force. Small gusts of high speed wind are called gusts. Strong
Winds of medium duration are called storms. Long lasting winds have different names like wind, Thunderstorms, storms and hurricanes. [3]

1.2. wind power
Wind turbines produce electrical power by using the power of the wind to drive an electric generator. [4] The
The generator generates electricity and passes through the tower to an available transformer and switches from

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Output voltage (typically around 700 V) a nationwide grid (33000 V) or individual use (about 240 V). [5] wind Electricity is an attractive and alternative power source for both large scale and small scale and distributed power generation application. One of the most important advantages of wind power is that it is modular and scalable. This It is often possible to find applications in both large wind farms and distributed power generation. as a party The effect of harnessing wind energy has also reduced dependence on fossil fuels.

With largely untapped wind power resources around the world and declining wind power costs, people Moving into the 21st Century with an Aggressive Initiative to Accelerate Wind Progress technology and further reducing its cost, creating new jobs and improving the quality of the environment.

Onshore wind is an economical source of electric power, competitive with coal or gas plants.

[6] [7] [8] The offshore wind is more stable and stronger than the onshore wind, and the visual impact of offshore farms is less, but

The cost of construction and maintenance is very high as compared to onshore construction and maintenance. [9]

1.3. Development of wind power in the world

There has been a rapid increase in the development of wind energy globally. use of wind for electricity generation is rapidly expanding, due to major technological improvements, industry maturity and growth Concerns related to greenhouse emissions associated with burning fossil fuels. Given the vast wind resources,

Only a small fraction of the usable wind potential is currently being harnessed. government and power

Industry regulations as well as government incentives play a big role in how soon wind power will take off Adopted. European countries have also exploited this energy source extensively. Germany, Denmark and Spain are notable users of wind energy. Denmark is pushing to produce 40% of its electricity through wind turbines. UK has is the largest wind power resource and it is ready for major expansion to reduce the cost of wind power. The Global Wind Energy Council (GWEC) released the Global Wind Report. had over 54 GW of wind power

Established in 2016 around the global market. GWEC's five-year forecast provides nearly 60 GW of new wind

Installations by 2017, to reach annual market of approximately 75 GW by 2021, cumulative growth

Installed capacity of over 800 GW by the end of 2021. [10]

Not only wind turbine technology but other technologies also develop day by day. with drones as an example turbine blades send into the sky and harness wind power as much as possible and send that energy back Cable. Also kites are used to harness wind energy.

1.4. Harnessing Wind Energy Potential in Sri Lanka

According to the wind mapping results of the National Renewable Energy Laboratory (NREL), there are several regions Concentrated wind power in Sri Lanka. These areas are largely concentrated in the northwestern coastal region. from the region of the Kalpitiya Peninsula to the Jaffna Peninsula and the central highlands in the interior of the country and adjacent areas. Other areas with notable areas of good wind resources include open land in the southern part of the North Central Province and the coastal region in the southern part of the Southern Province. High-quality wind measurement data were available to corroborate map estimates of wind resource in specific areas, Such as the Kalpitiya Peninsula, the Central Highlands and the South-East Coast. that's why it will be very helpful for To start many efforts on wind energy power generation in future which can benefit us to a great extent We have resources in Sri Lanka. [11] vertical axis wind turbine

VAWTs offer several advantages over traditional horizontal-axis wind turbines (HAWTs). they can be Wind farms are packed together, allowing more in a given space. they are calm, omnidirectional and They generate less force on the support structure. thus they do not require as much wind to generate electricity allowing them to stay closer to the ground where wind speeds are lower. being closer to the ground they are Can be easily maintained and installed over chimneys and similar tall structures. [14]

These all contribute to the energy production when the wind passes through the blades of the HAWT. when air passes through a VAWT, only a fraction of the blades generate torque while other portions only 'go along for the ride'. The result is a comparatively low efficiency in power generation. achieve higher efficiency It is somewhat trickier than VAWT on a smaller scale. This is because the performance of VAWT is very sensitive The lift/drag ratio of the blade and it's low Reynolds number conditions are not good for small applications. There are many obstacles to commercializing VAWTs. the first is that they are not as strong

By design as a HAWT. This is because the HAWT bears most of its stress where compared to the widely used VAWT model. The advantage of VAWT is only in niche environments. [15] Currently, VAWTs are not generated

have enough power that full-lifecycle accounting shows them to be profitable on cost or material Based on HAWT. VAWT designs have blades much closer to the ground than HAWTs, so they are

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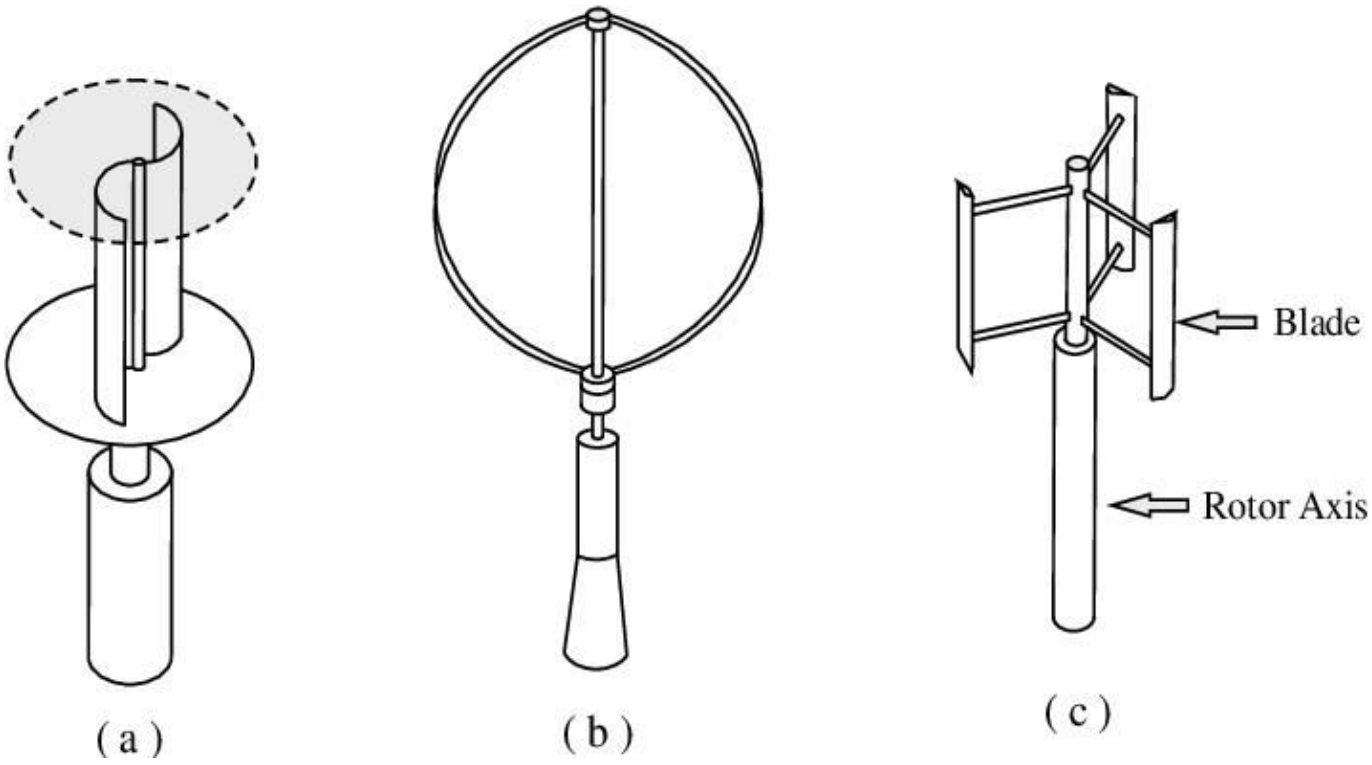
Losing a significant amount of air. [16]
There are two main types of VAWT called drag operated VAWT (Savonneys type) and lift operated VAWT. (Darius type). The Savonius type works similarly to a water wheel which uses drag force. On the other hand, The Darius type has blades similar to HAWTs. [15] The VAWT's main rotor shaft is arranged vertically.
Using that axis shaft the generator can be connected. The hull is unnecessary for this type of wind turbines. Because it accepts the wind which comes from any direction. Maximum possible efficiency of lift operated turbines are larger than drag driven turbines, the main focus today is on lift driven turbines. The first turbine of this design was patented in 1931 by G.J.M. Darius. [18]

Figure No. 01 shows that main types of vertical axis wind turbines



The main drawbacks of the early designs (Savonius, Darrius and Giromille) were the significant variation torque during each rotation and huge bending moment on the blade. Later projects addressed The issue of torque ripple by helically sweeping the blades. [17]

Darius Type Vertical Axis Wind Turbine
The Darius wind turbine was invented by Georges Jean Marie Darius and first patented in 1927. [19] Blades are Aerodynamically shaped, usually NACA style, with various layouts and with a fixed distance from rotation axis. [22] There are many challenges when protecting Darius turbines from extreme wind. circumstances and making it as a self-starter. This wind turbine is high speed and low torque turbine
Suitable for generating alternating current (AC). [19] The largest Darrieus wind turbine is located in Cap-Chat, Quebec. It is about 60 meters wide and about 100 meters long.
[31] Its nameplate capacity is 3.8 MW [21]
Picture number 02 shows how the Darius wind turbine moves with respect to the wind directions

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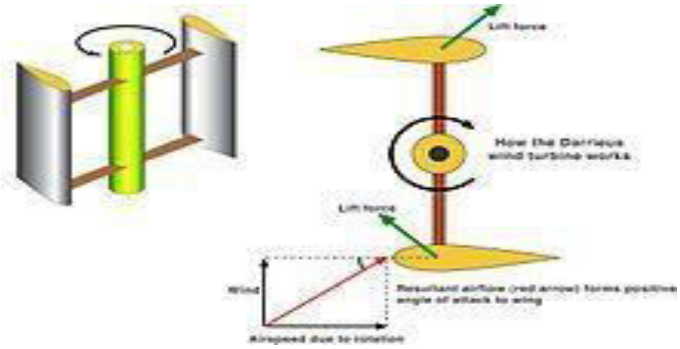

II. CONCLUSION

The Local officials as well as foreign officials in Sri Lanka will face a lot of problems in the near future Due to the lack of non-renewable energy sources. So, they are moving towards renewable energy sources like wind, Solar energy, tides, rain, ocean waves, geothermal heat…etc. If we can improve the performance of the Vertical Axis Wind Turbine (VAWT), it is of great benefit to officials. They can apply VAWT at every possible place and generate electricity Contribute to reducing CO2 production and economic growth. Thus, the researches related to VAWTs are acknowledged to have made substantial strides in this field. near future. comes to the country by starting the search there, it will be of benefit to the national Development.

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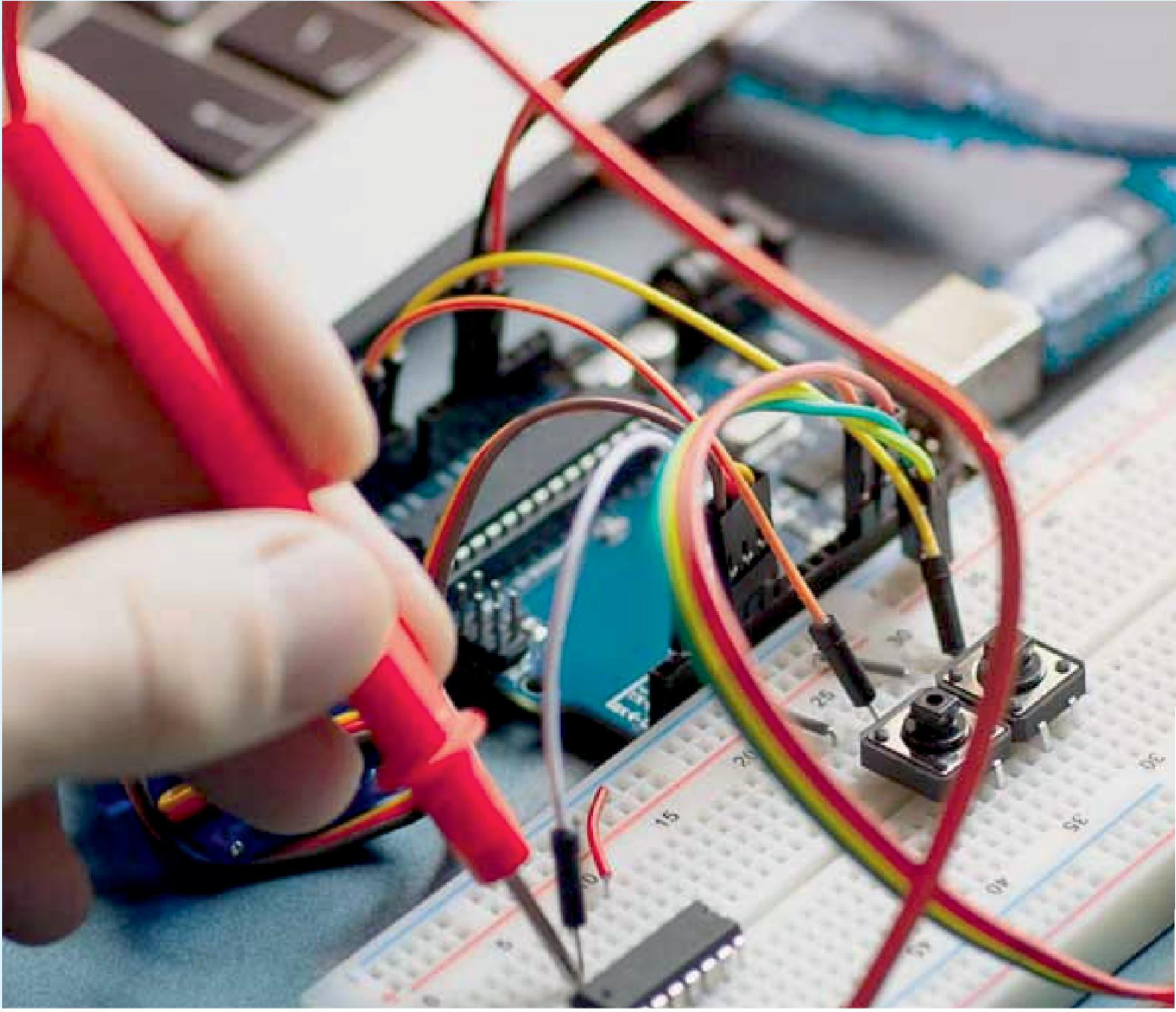

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