Research Article

Design of Small Horizontal Axis Wind Turbine

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Abstract: *Fuel price hikes have raised generation costs worldwide. The electrical industry still uses fossil fuels like coal, natural gas, and petroleum. End users will pay high power rates since utilization is not keeping pace with expenses. Malaysia, like others, has felt its implications. Therefore, comprehension of renewable energy is highly useful and must be fostered from the beginning, especially among students. With a 30% annual growth rate, wind energy provides the most notable and well-known renewable energy supply in the world. Numerous wind turbine studies have been conducted on various prospective sites, but only certain areas were suitable for wind. Hence, the primary goal of a small horizontal axis wind turbine prototype is to enhance knowledge regarding energy production via wind turbines. As well, renewable technology studies can be demonstrated practically without harming the exhaust air system. This prototype is developed in an appropriate size for research purposes, and the wind source used is unnatural. Variable Refrigerant Flow (VRF) outdoor systems were a viable option for capturing wind energy; additionally, their current contribution to energy production indirectly will be beneficial, particularly in urban areas.*

Keywords: renewable energy; wind turbine; Variable Refrigerant Flow (VRF) outdoor systems; urban areas.

1. INTRODUCTION

Wind power is now the world's fastest-growing energy technology among these because it is one of the most abundant energy sources(Ismail, Mohd Ali, Md Isa, Abdullah, & Mohd Zawawi, 2021). Wind generates 3% of global electricity and most industrial wind farms use large horizontal-axis wind turbines offshore or in windy areas to generate power. Buildings and residences limit wind energy in populous places (Loganathan et al., 2019). Further, location substantially influences the amount of energy produced by wind turbines. Incorporating environmental factors into the design of a small horizontal-axis wind turbine for a specific region could increase its power output(Khlaifat et al., 2020). Previous research has demonstrated that the development of feasible small wind turbines is proficient and cost-effective(Tummala et al., 2016) (Ismail, Mohd Ali, Md Isa, Abdullah, Muhammad, et al., 2021). The relevance of wind energy generation research should be considered from both perspectives, notably the location and size of the wind turbine. Therefore, this article exhibited the development of small horizontal axis wind turbines that is suitable for urban areas. The main objective is to enhance knowledge regarding energy production via wind turbines. As well, renewable technology studies can be demonstrated practically without harming the exhaust air system. Variable Refrigerant Flow (VRF) outdoor systems is a viable option for capturing wind energy; additionally, their current contribution to energy production was implicitly useful.

2. METHOD

2.1 Prototype development

Low wind speeds disadvantage fixed-bladed small wind turbines. Wind speed increases proportionally with height to the ground, and such wind turbines are generally mounted on rooftops, thus they encounter modest wind speeds <10 m/s(Aragón-González et al., 2022). This model, however, was set up slightly differently. It aligns with the direction of the wind released by the VRF, as illustrated in Figure 1.

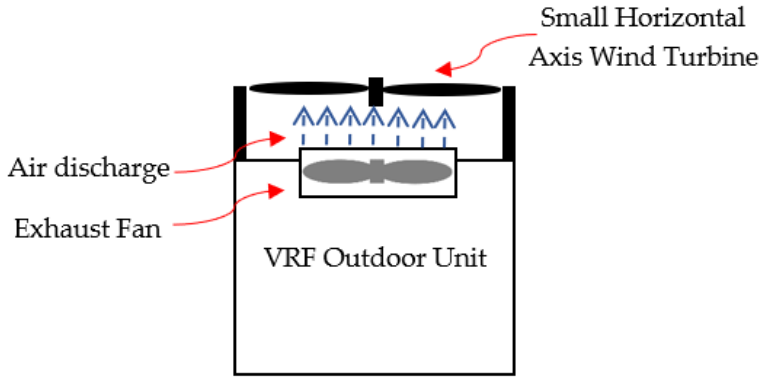

Figure 1: Air discharge direction through VRF Outdoor Unit

This prototype consists of a small horizontal axis wind turbine with three flat rectangular blades with an airfoil RG-15, a desirable low Reynolds number airfoil for small wind turbine blades (Leloudas et al., 2020). The study was carried out in an academic building where actual VRF was used as air discharged sources and a digital multimeter was utilized to measure voltage and current as shown in Figure 2. The general procedures were presented in Figure 3.

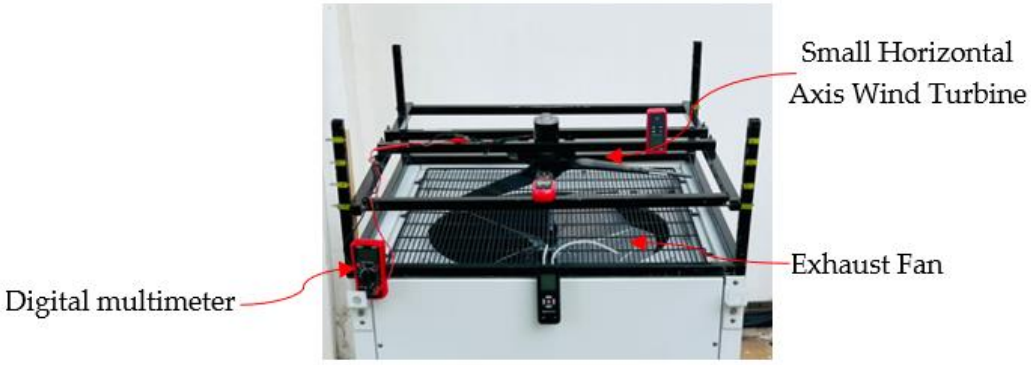

Figure 2: Experimental set-up

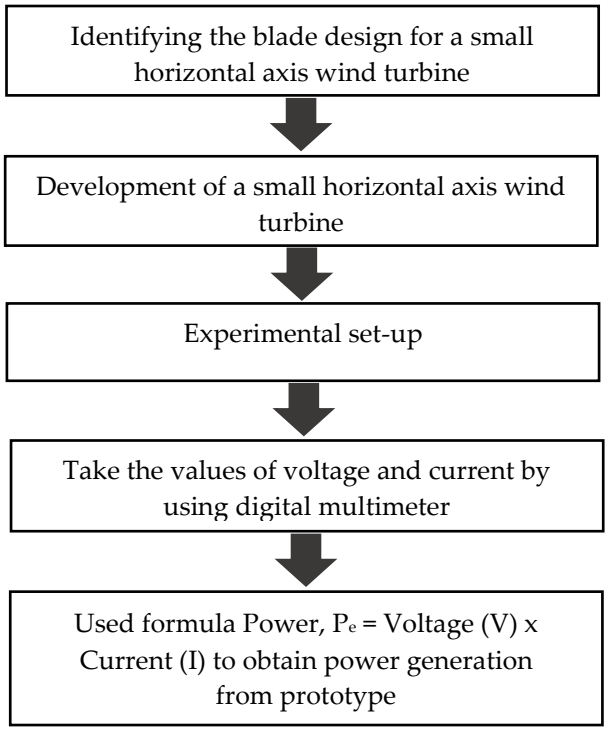

Figure 3: Methodology of the research

3. DISCUSSION

3.1 Power generation

This prototype was constructed in an adequate size for the purposes of study, and the wind source that was used was unnatural; it was waste air from an outdoor unit. According to the findings of the study, this compact wind turbine with a horizontal axis has the capability for producing approximately 14 watts of electrical power.

3.2 Novelty and commercialization value

Utilizing man-made devices as wind sources and the development of a small horizontal axis wind turbine with adequate analysis was the novelty of this research. The prototype represents a notable technological innovation that offers significant benefits in understanding the mechanisms of energy production from rotating machinery. In addition to harnessing the potential of wind energy, this approach has an identifiable impact on urban communities, particularly in Malaysia, by contributing to the conservation of their limited electricity resources for the long term. Furthermore, based on an extensive study and sufficient resources, this prototype demonstrates the substantial potential for commercialization and has the ability to yield unexpected profits.

4. CONCLUSION

The deployment of a small horizontal axis wind turbine offers benefits to the individual, community, and nation. The intent is to augment the understanding of green environmental technology and foster heightened consciousness of global issues. Thus, due to its competence to efficiently produce energy and its well-organized design, the prototype gives positive outcomes.

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