

## ELECTRICITY GENERATION SYSTEM FROM HIGHWAY

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### ABSTRACT

The increasing demand for electrical energy and the depletion of conventional fossil fuels have created the need for renewable energy sources. Wind energy is one of the most promising clean energy sources available today. Highways experience continuous movement of vehicles that produce significant airflow due to vehicle motion. This airflow contains kinetic energy that is generally wasted in the environment. The present work focuses on the design and development of a Vertical Axis Wind Turbine (VAWT) system capable of capturing airflow generated by moving vehicles on highways. The turbine consists of blades mounted on a vertical shaft supported by bearings and connected to a DC generator through a gear mechanism. When vehicles pass near the turbine installation, the airflow rotates the turbine blades, producing mechanical energy which is converted into electrical energy using the generator. The generated electricity is stored in a rechargeable battery and monitored using electrical measuring instruments. The proposed system is simple, economical, and suitable for small-scale renewable energy applications such as highway street lighting and traffic monitoring systems.

### 1. INTRODUCTION

Energy plays an important role in the development of modern society. Conventional energy sources such as coal, petroleum, and natural gas have been widely used for electricity generation. However, these resources are limited and cause environmental pollution.

Renewable energy sources such as solar, wind, hydro, and biomass provide sustainable alternatives for energy generation. Among these sources, wind energy is considered one of the most reliable and environmentally friendly methods of producing electricity.

Highways experience a large number of vehicles moving at high speeds. These vehicles create airflow due to aerodynamic drag and pressure differences around the vehicle body.

This airflow contains kinetic energy which is usually wasted. Installing small wind turbines near highways can capture this airflow and convert it into electrical energy.

Vertical Axis Wind Turbines (VAWT) are suitable for such applications because they can operate regardless of wind direction and require less installation space compared with horizontal wind turbines.

## **2. LITERATURE REVIEW**

Several researchers have studied vertical axis wind turbines for renewable energy applications.

Ulus et al. proposed an optimized vertical axis wind turbine system designed to capture vehicle-induced wind on highways. Their research showed that guide vane structures can improve turbine efficiency significantly.

Rajuke et al. developed a vertical axis wind turbine prototype installed along highway dividers. Their system was able to generate electrical output up to approximately 14.5 volts under favorable airflow conditions.

Liu et al. proposed a machine learning optimized vertical axis wind turbine design which improved power generation efficiency compared with traditional turbine structures.

These studies demonstrate that vehicle-generated wind energy can be used for small-scale electricity generation.

## **3. SYSTEM DESIGN AND METHODOLOGY**

The proposed system converts airflow generated by moving vehicles into electrical energy using a vertical axis wind turbine.

The system consists of the following components:

- ❖ Vertical Axis Wind Turbine Blades
- ❖ Vertical Shaft
- ❖ Bearings
- ❖ Gear Mechanism
- ❖ DC Generator
- ❖ Battery Storage System
- ❖ Electrical Measuring Instruments

When vehicles move near the turbine installation, airflow strikes the turbine blades and causes them to rotate. The rotating blades drive the vertical shaft.

A gear mechanism is used to increase rotational speed before transferring motion to the generator. The generator converts mechanical energy into electrical energy.

The generated electricity passes through a diode circuit and is stored in a rechargeable battery. A voltmeter and ammeter are used to monitor electrical output.

## 1. RESULT AND DISCUSSION

The fabricated vertical axis wind turbine system was tested under simulated airflow conditions similar to vehicle-generated wind.

The turbine blades rotated when airflow struck the blades. The rotational motion was transferred through the shaft and gear mechanism to the generator. The generator successfully produced electrical output which was stored in the battery.

The electrical output varied depending on airflow speed and turbine rotational speed. The results demonstrate that highway airflow can be utilized as a renewable energy source for small-scale electricity generation.

## 2. APPLICATIONS

The proposed vertical axis wind turbine system can be used in several applications such as:

- ❖ Highway street lighting
- ❖ Traffic signal power supply
- ❖ Roadside monitoring systems
- ❖ Charging small electronic devices
- ❖ Renewable energy demonstration projects

## 3. CONCLUSION

1. The vertical axis wind turbine system developed in this project successfully demonstrates the concept of generating electricity from airflow produced by moving vehicles on highways.
2. The system is simple in design, cost-effective, and environmentally friendly.
3. The generated electrical energy can be used for small applications such as street lighting and traffic monitoring systems.
4. The project highlights the potential of utilizing wasted highway airflow as a renewable energy source.
5. Future improvements may include aerodynamic optimization of turbine blades and integration of more efficient generators to increase power output.