

Turbine for Electricity Generation Using Chimney Flue Gases: A short review

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Abstract: A chimney is a type of architectural ventilation system made of masonry, clay, or metal that is used to isolate hot, dangerous exhaust gases or smoke from inhabited areas produced by appliances such as a boiler, stove, furnace, incinerator, or fireplace. Chimneys are usually vertical, or as close to vertical as possible, to ensure that the gases flow smoothly and attract air into the combustion, a phenomenon known as the stack, or chimney effect. This study proposes a novel idea for on-site power generation by harvesting kinetic energy from synthetic wind resources using ducted turbine systems. An attached horizontal axis ducted turbine uses the kinetic energy of flue gases to generate power at the chimney's top.

Keywords: Turbine, flue gases, chimney, electricity generation

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1. Introduction

A chimney is a masonry, clay, or metal architectural ventilation system that separates hot, hazardous exhaust gases or smoke from inhabited areas produced by a boiler, stove, furnace, incinerator, or fireplace. Chimneys are usually vertical, or as close to vertical as possible, to ensure that gases flow smoothly and draw air into the combustion via the stack, or chimney effect. This study introduces a novel concept for extracting kinetic energy from artificial wind resources and generating on-site power with a ducted turbine system. A horizontal axis ducted turbine is attached to the top of the chimney and generates power by harnessing the kinetic energy of flue gases.

The objective of the present work is,

- On-site power generation and storage.
- Monitoring of battery voltage.
- Monitoring of parameters like temperature, humidity and air quality index.

There are various sources of flue gases in industrial as well as commercial establishments. This flue gases are released using a chimney which can be utilised for generation of electricity. Turbines can be used inside the chimney which can be powered by the flue gases in order to convert mechanical energy to electrical energy which can then be used for powering appliances. Along with this we are also monitoring the voltage of the battery, temperature, humidity as well as air quality index which widens the scope of the project.

2. Literature Survey & Gap Analysis

As the need for electricity rises daily, it is crucial for the nation's development to supply all of the electricity needed by people. It may see the end of conventional energy sources including coal, gasoline, and diesel after two to three decades. Either the right use of energy sources must be made, or the current generation capacity must be made more energy efficient, to meet this growing demand. We will use technology in this project that complies with the legislation of energy conservation. The statement reads, "Energy neither creates nor destroys, but merely transforms from one form to another." We will use turbines in traditional chimneys to convert mechanical energy from flue gases to electrical energy in accordance with the law of conservation of energy.

The following most relevant research papers are referred in context of this research. The research gap of the literatures is identified for the future scope of the work.

Table 1. Methodology, key findings and research gap from the relevant research paper.

Sr. No.	Author Name	Year	Methodology & Key Findings	Research Gap
1.	Harjeet S. Mann and Pradeep K. Singh	2017	The collection of kinetic energy from artificial wind resources using ducted turbine systems is an innovative way to generate power locally.	Monitoring and control of parameters are not taken into account
2.	Chen T Y et. al.	2012	The testing results show that flanged diffusers significantly increase rotor speed, power, and torque outputs depending on rotor solidity and wind speed. The length and angle of the diffuser have a significant impact on wind speed. As a result, it appears that the geometry of a duct has a significant impact on how well the turbine operates.	Monitoring of additional factors like temperature and gas is not taken into account.
3.	Chaudhari C D et. al.	2013	Used ANSYS FLUENT 14.0 to research how air flows through venturi and simulate how kinetic energy improves with increasing wind speed.	The system's geometry and parameter monitoring were not taken into account.
4.	Ahmed N A and Cameron M.	2014	Presented a thorough analysis based on research on both existing and developing wind power technology, as well as the difficulties this industry is currently facing.	Power generation is taken into account without any information from the various sensors.
5.	Falohun et. al.	2016	Using the MQ-9 chemical sensor, a gas detector with an audible/visual alarm is created to find gas leaks.	Power generation was not considered because there was no research on the flue gas source.
6.	Katole, K. R. et. al.	2016	A system that employs Arduino to find dangerous gases. It features gas sensors that can detect butane, methane, and carbon monoxide, and the LCD display displays the % concentration of each gas.	There were no temperature, voltage, or power generating sensors employed; only gas sensors.
7.	B. S. Rao et. al.	2016	Presented the system for monitoring weather based on IoT. The system measured various parameters such as temperature values, light intensity, and CO level	IoT-based data monitoring without requiring flue gases for power generation.

3. Methodology with Flow chart

- i The main purpose of the project is to generate electricity using exhaust gases emitted from chimney.
- ii This is done by making use of horizontal axis turbine in order to convert mechanical energy to electrical energy.
- iii The power generated is stored using rechargeable batteries.
- iv It has a microcontroller unit that monitors voltage of the battery along with temperature, humidity and air quality index remotely.
- v Data is stored on cloud server and can be viewed on Android App.

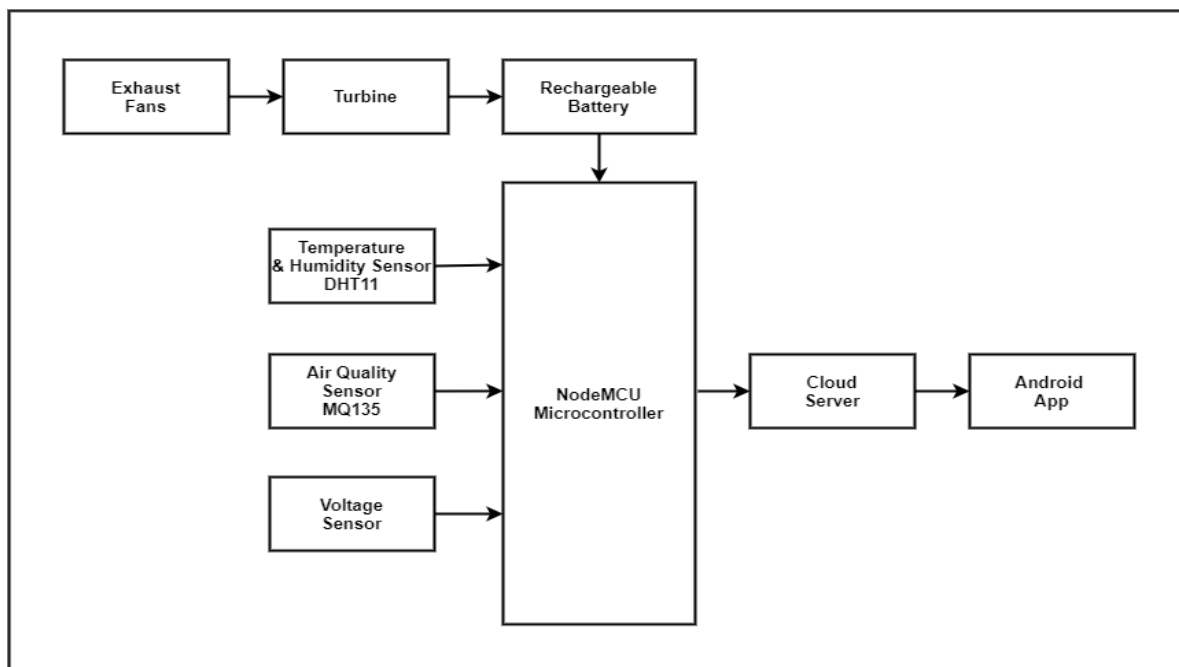


Figure 1. Flowchart for electricity generation using exhaust gases emitted from chimney

4. Conclusion

A chimney is a masonry, clay, or metal architectural ventilation system used to isolate hot, dangerous exhaust gases or smoke from inhabited areas produced by appliances such as a boiler, stove, furnace, incinerator, or fireplace. Chimneys are typically vertical, or as near vertical as possible, to ensure that gases flow smoothly and attract air into the combustion, a phenomenon known as the stack, or chimney effect. This research proposes a novel method for generating on-site power by harvesting kinetic energy from synthetic wind resources using ducted turbine systems. An attached horizontal axis ducted turbine generates power at the chimney's top by utilizing the kinetic energy of flue gases.

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