IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 7.105 ⁜ Vol. 9, Issue 5, May 2022

DOI: 10.17148/IARJSET.2022.9519

Air Purification Using Renewable Energy

Nitin Tripathi[1], Abhimanyu Yadav[2], Anil Kr. Sharma[3], Ankit Kumar[4], Deepak Kr. Pandey[5]

Assistant Professor, Mechanical Engineering, Buddha Institute of Technology, Gorakhpur, Indian[1]

Student, Mechanical Engineering, Buddha Institute of Technology, Gorakhpur, India[2]

Student, Mechanical Engineering, Buddha Institute of Technology, Gorakhpur, India[3]

Student, Mechanical Engineering, Buddha Institute of Technology, Gorakhpur, India[4]

Student, Mechanical Engineering, Buddha Institute of Technology, Gorakhpur, India[5]

Abstract: Recently, the problem of air pollution is emerging due to increasing demand of fossil fuel, vehicle and factory. Especially, one of the biggest problems is increase of a fine dust. Since fine dust is very fine particles of 10μm or less and it is difficult to remove, because it cannot be seen with naked eye. To sort out this problem air purifier technology receives attention because of the Fine dust problem. The air cleaning systems are widely used at Indoor. However, the problem of air pollution is generated at Highway and factory. Therefore, it is necessary to study the air Purification system to be applied to factories and highways. This paper describes design and hardware implementation of air purifier for fine dust system. Hybrid power source and batteries are utilized to develop a air purifier machine. The air pollution these days is a serious environmental concern and it is not just a exclusive fact but a drastic reality which is creating problems for the mankind such as some serious health issues. In some parts of the world the air quality index have reached to an watertight level which demands for a solution now. Hence, the purpose of this report is to tackle this problem at a large scale by providing with "air purification using renewable hybrid energy (wind energy + solar energy)" for purify the air of outdoors. This is an artificially intelligent mobile air purifier for "outdoors". This ability of providing with such a smart-sensing, self-driving machine is the advantage of the report because other air purifiers exist but they are made for indoors, they do not have mobility and also do not possess AI capabilities. This purification system is based on the YOLO algorithm.

Keywords: Renewable Hybrid Energy, Wind Energy, Solar Energy, YOLO Algorithm.

I. INTRODUCTION

One of the biggest challenges that the world faces today is providing clean and sustainable energy to future generations. Recently, with the development of industry, the use of fossil Fuels and the demand for personal vehicles are increasing hence, the quantities of fine dust are also increasing. Most of the fine dust is composed of Sulfate and Nitrate, which cause smog and have adverse effects on human Health. In particular, the fine dust is difficult to remove because it can be checked by naked eyes and cannot be easily removed. The fine dust is a very small particle of 10μm or less, which is difficult to be visually recognized. So it can't be completely removed without help of the fine dust removal system.

With the Industrial civilization, a lot of things around the world have changed drastically. Most of these things have changed for good but some of them resulted in pure harm. One of problem is, "air pollution". Air pollution has become one of the most significant and deadliest causes of deaths today. The World Health Organization (WHO) stated that around 6.5 million deaths were caused by air pollution in the year 2012 translating to 11.6% of total global deaths. WHO states that air pollution is the cause of one-third of deaths caused due to stroke, lung cancer, and chronic respiratory diseases. Approximately, 92% of the world's population is exposed to air pollution levels that are beyond the permissible limits prescribed by WHO.

In many parts of the world it is a highly critical problem. Some of the most polluted city around the world have been declared as a gas chamber, e.g.: New Delhi (India), Zabol (Iran), Bamenda (Cameroon) and many more. According to WHO, the atmosphere in such cities contain dangerously some major level of miniscule microscopic pollutants, tiny in size and hence easily mixed in the blood stream via the lungs, this problem is the sole reason for 7 million premature deaths every year.

II. AIM & OBJECTIVE

The basic and main aim of this paper is to, an attempt is made to thoroughly review previous research work conducted on wind energy systems that are hybridized with a PV system. This paper explores the most technical issues on wind drive hybrid systems and proposes possible solutions that can arise as a result of process integration in off-grid and grid-

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connected modes. A general introduction to wind energy, including how wind energy can be harvested, as well as recent progress and development of wind energy are discussed. With the special attention given to the issues related to the wind and photovoltaic (Wind-PV) systems. Throughout the chapter emphasis was made on modelling, design, and optimization and sensitivity analysis issues, and control strategies used to minimize risk as well as energy wastage. The reported reviewed results in this chapter will be a valuable-researchers and practicing engineers involved in the design and development of wind energy systems. The main objective of this project is to convert non-conventional energy into electrical energy which is later used as energy supplier for purification of air. Utilization of these type of project can resolve the energy crisis in the world.

III. LITERATURE REVIEW

Many research works have been conducted in the past in order to find a solution for the problem of air pollution but those were not powerfully efficient due to lack of computational ability. Also, most of the purifiers created in the past were specifically made for the indoor applications. This point of the indoor purifier contrasts with the ideology of this paper. This paper proposes an air purifier which is: Able to run by using renewable hybrid energy. It is also able to sense the AQI of a place. Based on the AQI it matches this generated index with a threshold value of safe AQI. If the generated AQI is more then it starts its purification process but if the air quality index is low then it stop. This methodology, as a whole system gives a direct solution to the problem of air pollution. Also, this whole process makes it a stronger air purifier not only in just providing good healthy air but also it is better in the technological point of view. The earliest approaches were the chemical approaches, these used the ozone corona, pre-charger: an ozone decomposing and a semiconductor filter which is actually electrified. This system is also equipped with a safety control mechanism [16]. This type of purifier was named AIP and lacked very much computational ability. Then came the ones which use ultra-high purity inert gases in order to purify. This type of technology is based on two types of technologies, one is the POU purifier and the other is the based on the metalized Ni pellets. Then, in the upcoming years, came a generator which used the negative [1]. Till now all the purifiers were computationally very less competent. None of them used the artificially intelligence or were even close to that. Also, all of them were very much focussed on the indoor purifiers. All of these used the concepts from the chemistry to solve the problem of the air purification. After all of this, then came the air purifiers which used the AHP methodology [3]. This type of the air purifier used BAP-1700 as the air purifier equipment. After all of these electrically and chemically supported air purifiers then came the age of the smart air purifiers. Following the already defined technology, then came the air purifiers which included the use of IOT. In 2016, came the intelligent bio-tank air purifiers which is an indoor home air monitoring and controlling system that is considered as a natural air indoor air purifier. That is this system, aims at improving its indoor air quality based on the usage of the IOT [17]. Subsequently after the use of the IOT, the indoor mobile biological air purifiers came which was equipped with the pedestrian tracking system [4]. Our air purifier is quite same with this one, except that ours is an outdoor air purifier and also it is formulated with the latest technology which is the deep-learning along with the reinforcement learning. Some of the researches provided not only the function of the air purification but also, where a combination of other functions too. To support this type of the research, an intelligent air purifier with sweeper combination system was developed [5]. With the coming era of deep-learning and the reinforcement learning, a new and efficient approach was developed deep reinforcement learning. This paper uses this approach in order to handle the problem of the air pollution control system. The reinforcement learning used in the model, gives an edge to this technology than the others. This approach helps the model to work in a particular way which helps the robot to analyse its each and every action, after the analyses the robot is able to realize if it has done some mistake or not and then perform another action. In this way each and every action which the robot performs is an optimized action and maximised award.

IV. COMPONENTS USED

1. Chamber

The chamber is the main part of the air purifier. The polluted air from the environment is sucked into the chamber using a fan. It is designed in rectangular cross-section. In the chamber the rack arrangement is close fitted containing the atomizers and the baffle arrangement. It is designed to provide adequate space for atomization by atomizers and efficient adhering of particles with water droplets. The outlet side of the chamber is elevated from the base to reduce the air flow speed and amount of moisture in the clean air. A clearance is provided at the bottom in the chamber for easy flow of water containing particulate matter.

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Fig. 1: Chamber

2. Atomizer

The atomizer is used to convert water into very fine droplets. There are two atomizers in the air purification system. The atomizers used in this system are solid cone type. High pressure water is pumped at inlet of the atomizer. In the atomizer, the pressure head of water is converted into kinetic head by the Bernoulli's principle, this result in high velocity and low pressure of water at the outlet. When this high velocity water through the atomizer outlet comes in contact with the air, the air friction acts and the kinetic head of the water is converted into surface energy. Thus, very fine droplets are obtained.

Fig. 2: Atomizer

3. Pump

A pump is installed in the device. This water is pumped at high pressure and supplied through the pipes into the atomizers. This is a booster pump which provides reliable inlet pressure. This pump is capable of continuous duty.

Fig. 3: Pump

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4. Fan

A 750 RPM fan is installed at the vent of the device. This fan has two implications that are to suck polluted air from the inlet environment into the chamber and also to flow away the clean air into the outlet environment.

Fig. 4: Fan

5. Arduino Uno Atmega328p

Arduino is an open-source electronics platform or board which can be easily programmed, erased and reprogrammed at any instant of time. Introduced in 2005 the Arduino platform was designed to provide an inexpensive and easy way for hobbyists, students and professionals to create devices that interact with their environment using sensors and actuators. The Arduino IDE provides a simplified integrated platform which can run on regular personal computers and allows users to write programs for Arduino using embedded C The Arduino Uno is a microcontroller board based on the atmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 mhz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

Fig. 5: Arduino Uno Atmega328p

6. HEPA + Carbon Filter

Let's first define HEPA

HEPA stands for high-efficiency particulate air. It's defined as a "mechanical" filter because air must be forced through it for it to work. It's not like an ozone generator where it produces ozone or an ionizer, which is a completely different system.

Carbon filters use activated carbon to remove microbes and other impurities in the air. Unlike HEPA filters, carbon uses absorption, taking the contaminants into its porous surface. It is used in water purification as well as air filtering, among other things like gas processing. It is effective in processing microbes, but can't be used for hospitals or clean rooms.

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Fig. 6: HEPA + Carbon Filter

7. Windmill

A windmill is a structure that converts wind power into rotational energy by means of vanes called sails or blades, specifically to mill grain, but the term is also extended to windpumps, wind turbines and other applications.

In other words, A windmill is defined as a machine that converts the kinetic energy of the wind into mechanical energy. All the blades of windmill always rotate in a clockwise direction. The first windmill was designed in the year 1854 by Daniel Halladay from the United States.

Fig. 7: Windmill

8. Solar Panel

There is an installation of a 100-watt solar panel. This panel is used to produce electricity from radiation of sunrays. The panel consists of a grid of inter connected photovoltaic cells.

Fig. 8: Solar Panel

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9. Electrical Converter

There is a 500-watt capacity converter installed in device which is used to convert DC voltage of solar panel power source into AC voltage which is used charge the battery in the system.

Fig. 9: Electrical Converter

10. Battery

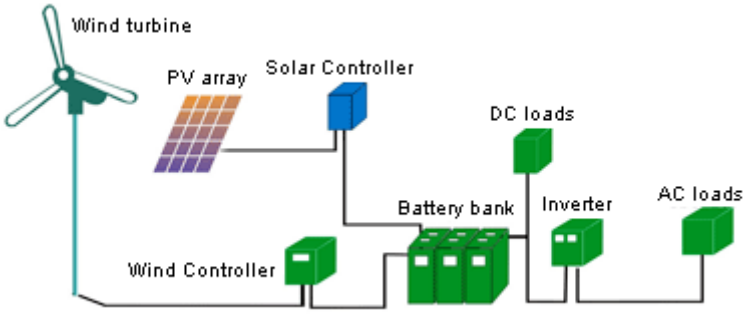
A battery with a high capacity and a low power rating is installed which delivers a low amount of electricity (enough to run a fan and pump) for a long time.

Fig. 10: Battery

V. Modelling and Design of PV-Wind System

It will be good to start with hybrid energy system (HES). Hybrid energy system is the engineering design of hybridizing power supply components or pairing them, for example, arranging diverse energy resources to work in parallel (equivalent) is very common in power. So, hybridizing is defined as forming crossbreed of pairs of agent for working together to achieve a purpose. Thus, hybridizing is to manually or automatically synchronize two or more electric power generator resources or components to supply electric power to the grid, therefore forming hybrid energy system.

The schematic diagram of the overall system is shown in Figure:



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VI. WORKING

The Solar Panel captures sunlight and converts solar-energy into electrical-energy and also The wind strikes and rotates the propeller blades which are attached to rotor, it further rotates the shaft of the dynamo which produces electrical energy, then sends it to electric Charge Controller to handle the unstable current. The electric Charge Controller supplies stabilized current with12 Volts to the battery. The battery stores the current according to its respective capacity. From Battery to its connection to Electronic Speed Controller at 12V, the speed controller powers 12V Brushless DC Motor Fan and Arduino Board through speed controller's pins connected as shown. In order to control DC motor's speed, the speed controller needs to take input readings from another device using its signal pin, which in this case is Arduino board. To provide certain input to speed controller, Arduino board reads potentiometer (10K ohm used), supplies relative input to speed controller, and helps in motor speed control. Instead of using Arduino board and Potentiometer's speed control, a Servo-Tester can also be used. The Fan then pushes Polluted Air through the Air Filters, where various types of filters provide filtration and outputs clean air. Air Quality sensors MQ135 connected to front and back of Air Purifier read the Polluted Air going inside and Clean Air coming outside.

VII. CONCLUSION

This fabricated hybrid Powered Air Purifier not only provides clean air but also keeps in consideration that people worry more about unnecessary high electricity consumption. In addition, this low-cost hybrid-Powered Air-Purifier can be used in those places where electricity is not available. It can also be made a portable air purifier and remotely controllable. By adding temperature-controlled cooling via DHT11 and adding timed fragrance dispenser using a sprayer, providing a unique, luxurious and affordable product in the market at less cost. This paper presents detailed work conducted on hybrid system based on PV and Wind. The paper systematically shows the different methodology used in the design, simulation, optimization and techno economic aspects of PV-Wind Systems. Some design and application of the hybrid PV-Wind are discussed. Hybrid renewable energy power system optimal design includes feasibility studies, model-based design, simulation and integration of several hybrid renewable energy resources, energy conditioner, and hybrid energy storage system and hybrid controller for automation to achieve power supply reliability. A hybrid renewable energy system (HRES) technology for reliable power supply has challenges in the design process. Thus, hybrid energy harvester, energy conditioner, energy storage and controller feasibilities, selection and unit sizing, and system configurations are necessary procedures to be carried out. Hybrid energy system components for power, reliability applications related to hybrid energy systems, power system has been reviewed above. In order to highlight the merits of the optimal design of hybrid energy system with a promising sustainable solution for power supply reliability. The solar photovoltaic flat plate has of enormous adaptable models with the adequate alternative energy potential that could possibly replace conventional fossil fuel system. Hybrid renewable energy power system can offer socio-economic return when enough power is available in rural areas as business activities is going to be established as the communities do some corn/wood mills, small scale industrial ventures to engage more youth in entrepreneurship.

ACKNOWLEDGMENT

We would like to express our special thanks of gratitude to our mentors **Mr. Jawed Rafique** And **Mr. Nitin Tripathi** as well as our department who gave us the golden opportunity to do this wonderful project on the topic Air Purification Using Renewable Hybrid Energy, which helped us to learn a lot in the research in the course of completion of project.

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