ISSN (O) 2321-2004, ISSN (P) 2321-5526

IJIREEICE

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 8, August 2021

DOI 10.17148/IJIREEICE.2021.9808

Smart Air Purifier Using HVDC

Ramya K R[1], Dishanth K Rajpurohit[2], Sagar D B[3],Sree Harsha N K[4], Vanitha B[5]

Associate Professor, Department of Electrical and Electronics Engineering, KSSEM, Bengaluru, India[1]

UG Student, Department of Electrical and Electronics Engineering, KSSEM, Bengaluru, India[2-5]

Abstract:Particulate matter pollution becomes an increasingly important problem in developing countries and poses a hazard to human health especially in Indoor environment. To reduce the human exposure to these indoor pollutants, the negative ion generator has been widely used which uses ionization. Theproposed solution is to develop a high voltage DC generator which can be used for ionization.Theentire processis controlled and monitoredusing micro-controller board and sensors. The control and monitoring of the air purification system is successfully able to measure the quality of air and also to activate the ionisation process. The safety feature built in the system is able to sense LPG and turns off the ionisation process preventing fire.

Keywords: Air purifier, ionization, HVDC, microcontroller.

I. INTRODUCTION

Air pollution is a mixture of solid particles and gases in the air. The major outdoor pollution sources include vehicles, power generation, building heating systems, agriculture/waste incineration, and industry. Household air pollution is one of the leading causes of disease and premature death in the developing world.Exposure to smoke from cooking fires causes 3.8 million premature deaths each year, mostly in low- and middle-income countries. Particulate matter is a pollutant of special concern. Many studies have demonstrated a direct relationship between exposure to particulate matter and negative health impacts. Since they are so small and light, fine particles tend to stay longer in the air than heavier particles. This increases the chances of humans and animals inhaling them into the bodies. Owing to their minute size, particles smaller than 2.5 μm can bypass the nose and throat and penetrate deep into the lungs and some may even enter the circulatory system. Smaller-diameter and ultrafine particles are generally more dangerous. Exposure to indoor air pollutants can lead to a wide range of adverse health outcomes in both children and adults. Members of households that rely on polluting fuels and devices also suffer a higher risk of burns, poisonings, musculoskeletal injuries, and accidents.

II. LITERATURE SURVEY

C. Lai, M. Pan, and M. Yang et.al [1] in this paper a negative ion generating circuit with 8kV/4kV dual output is developed for air purifier applications, whose circuit generates the high electric field to ionize the air. The number of active particles increases in the air, which react with the dust particles present in the air and make the air clean. The circuit analysis and results are also presented in the paper. The proposed negative ion driving circuit is composed of a low-cost 555 timer-based signal generator, a two-transformer paralleled Flyback converter with voltage-doubler rectifier and the output loads. The circuit is built in a prototype whose results are verified. While the circuit consists of simple components, the circuit configuration proposed in the paper does not permit a duty cycle of less than 50% which is not desirable. And the use of Flyback transformers increases the ripple current and losses in the system.

X. Yang, L. Yang, and J. Zhang et.al [2] portrays the Outdoor air pollution which is a major environmental health problem worldwide, especially in areas with low- and middle-income. Among all types of pollutants, particulate matter affects more people and attracts increasing attention from researchers recently. Airborne particulate matter consists of solid and liquid, organic and inorganic substances and is usually grouped into coarse particles and fine particles. Fine particles sometimes refer to particles with aerodynamic diameters of and less than 2.5μm, or simply, PM2.5 is strongly associated with mortality and other endpoints such as hospitalization for the cardio-pulmonary disease. Through infiltration, natural and mechanical ventilation, outdoor pollutants can go indoor with air movements. Furthermore, biomass burning, building materials, and furnishings, etc. may also contribute to indoor particulates, which directly affect the health and comfort of the building occupants.S. Ketkaew [3] in this paper thrusts on the Air cleaner by using high voltage electrostatic is making the surrounding air to be the Air Ionizer by feeding the high-pressure direct current to the conductor that causes the high condensed electric field. When the atom or molecule of air passes, the air will be ionized. The dirty air, for instance, dust smoke and pollution are mixed. Electrically charged dust will move to touch on collector plates which have the opposite electric charge.

ISSN (O) 2321-2004, ISSN (P) 2321-5526

IJIREEICE

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 8, August 2021

DOI 10.17148/IJIREEICE.2021.9808

J.D. Cockcroft, E.T.S. Walton et.al [4] mainly focus on the method that is used to generate high DC voltages for the acceleration of protons. The method has been developed by which the voltage of a transformer can be rectified and multiplied several times by an arrangement of valves (diodes) and condensers. A rectifier system has been built consisting of four glass cylinders placed end to end, and arranged in the form of a tower 12 feet high, the cylinders containing suitable electrodes and hot filaments and being evacuated continuously.

III.METHODOLOGY

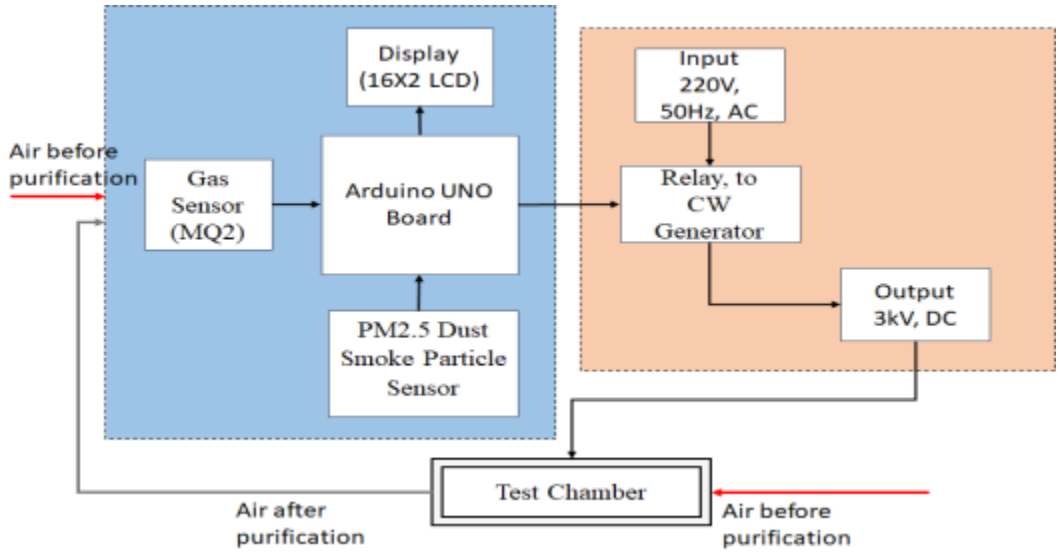

Fig1:Block Diagram of the HVDC air purifier system

Steps:

The air before the purification enters the test chamber where the different sensors are placed. The particulate matter sensor (SHARP GP2Y1010AU) detects the quality of air present in the surrounding. If the quality of air purity is above the prescribed level then the Arduino board triggers the SPDT relay switch, which turns on the Cockcroft Walton voltage multiplier and ionisation of air starts. The purity of air is continuously monitored by this sensor.

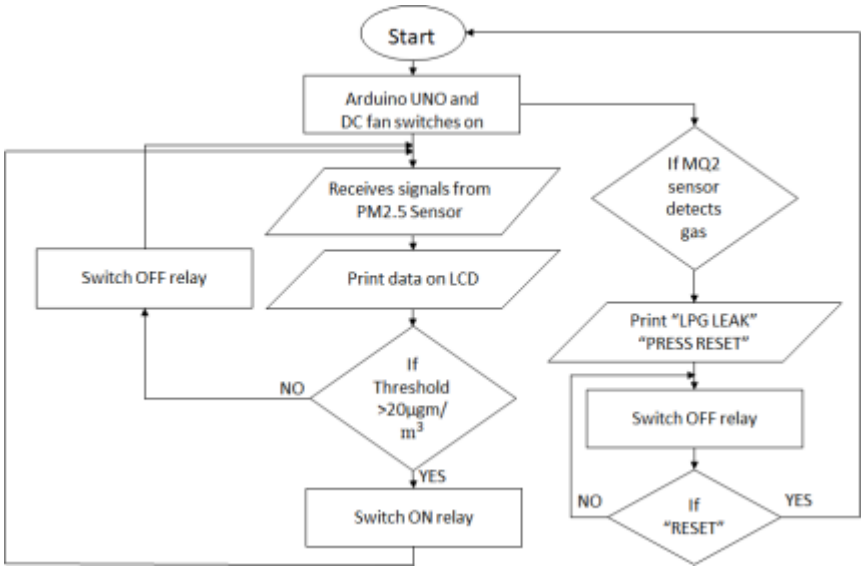

Fig2:Block Diagram of the HVDC air purifier system

ISSN (O) 2321-2004, ISSN (P) 2321-5526

IJIREEICE

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 9, Issue 8, August 2021

DOI 10.17148/IJIREEICE.2021.9808

Fig 2 shows a flow chart of the program of operations carries out by the system. The initial conditions are set accordingly. The Arduino Uno is the main microcontroller that receives the signals from the sensors and also gives signals to perform the tasks. Initially, the Arduino switches on and starts to read from the PM 2.5 dust sensor where the pollution concentration is detected and the same is given as a digital readout to the user. If the sensor reads more than 20µgm/m3 then the Arduino triggers the relay to start the operation of air purification. During this process, if the gas sensor (MQ2) senses combustible gas then a signal is sent to the Arduino which deactivates the relay and shuts off the purification system to avoid fire. The system will reset only when the user presses the reset button of the Arduino Uno board. This is a safety system that is integrated into this system. The system continues to operate until the suspended particles in the air reduce to the nominal value.

IV. CONCLUSION

The smart air purification system is designed to be able to tell the user about the quality of air and also to perform the operations to purify it. The purification of air done through the ionisation process and is capable to remove suspended particles and harmful microorganisms from the air.The ionisation of air is done by generating high voltage using Cockraft-Walton type voltage multiplier. The voltage generated using a cascaded Cockroft-Walton Voltage multiplier circuit consumes less power and is energy efficient. The control and monitoring of the air purification system is successfully able to measure the quality of air and also to activate the ionisation process. The safety feature built in the system is able to sense LPG and turns off the ionisation process preventing fire. Hence system is an overall package designed to safely reduce indoor air pollution.

REFERENCES

[1] M. P. a. M. Y. C. Lai, "Study and development of a negative ion driving circuit with 8kV/4kV dual-output for air purifier.," IEEE International Symposium on Consumer Electronics (ISCE), pp. 39-40, 2013.
[2] L. Y. a. J. Z. X. Yang, "A Wi-Fi enabled indoor air quality monitoring and control system: The design and control experiments," 13th IEEE International Conference on Control & Automation (ICCA), pp. 927-932, 2017.
[3] S. Ketkaew, "Air cleaner by using high voltage electrostatic," International Conference on Power System Technology, vol. 3, pp. 1611-1614, 2002.
[4] E. W. J.D. Cockcroft, "Further developments on the method of obtaining high-velocity positive ions," Proc. Roy. Soc. (London), vol. 131, pp. 619, 1932.