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IoT Enabled Air Purifier

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Abstract - *Air pollution became the one of the major problems across the globe, where are several factors contributing it. To purify the polluted air, Air purifier is primary need. Hence by keeping this importance in modern life we have created an air purifier which works on the principle of IONIZATION. The output of this is the purified air which is free of carbon and other polluting factors. Our Ionizing air purifier can provide the similarly equivalent grade of service like dyson's at a very moderate cost which is affordable even by a common person and can perform all functions performed by the dyson air purifiers and can also provide the real time analytics regarding the air quality of its surroundings.*

Key Words: IoT, Aurdino, Air Purifier, Node MCU ESP8266.

1. INTRODUCTION

IoT enabled air purifier using ionization is a technology that can help everyone to lead a happy and healthy life with lost cost compared to all other available air purifiers like air purifiers with HEPA(high efficience particulate air)filters and electrostatic air purifiers.

Hak-joon-kim, Bangow Han, Chang Gyu woo, Yong-jim Kim, GI-Teak Lim,Weon Gyu Shin "air cleaning performance of a novel electrostatic air purifier using an activated carbon fiber filter for passenger cars,"Nov-2017 according to this article it was developed for passenger cars .They developed a novel electrostatic air purifier using a carbon fiber brush charger combined with a metallic collection rod and an activated carbon fiber (ACF) sheet to improve the indoor air quality of passenger vehicles. The ACF sheet was used to apply electrostatic forces to move charged particles toward a collection rod and simultaneously adsorb gas. The cylindrical air purifier (diameter: 100 mm, length: 190 mm) was composed of a conductive brush charger and an electrostatic collection rod for particle removal, as well as an ACF filter for gas removal. The flow rate of the device was approximately 209-360 L/min. The novel purifier was tested in a 1-m 3 chamber with particles 0.3 μm in diameter and three gases: ammonia, acetic acid, and acetaldehyde. The gas cleaning performance of the purifier was compared with that of a commercial purifier with a high-efficiency particulate air (HEPA) filter, activated carbon pellets, and alumina balls. The clean air delivery rate (CADR) of the novel electrostatic air cleaner was 0.219 m 3 /min, 35% higher than that of the HEPA filter. The CADRs of the ESP air cleaner for the test gases were 0.25, 0.19, and 0.19 m 3 /min, respectively, indicating that the novel ESP air cleaner reduced the gases 308%, 204%, and 327%, respectively, faster than the commercial purifier.

This paper studies a novel negative ion generator for air purifier application. The proposed circuit can use the battery as an input dc voltage to produce dual-output high voltage, increasing the negative ions in air, improving the air quality. This paper contribute five sections, in first section give the brief introduction of air purifier see above section, Design of Air Purifier using IoT and Results see in section two and three, section four give the conclusion and finally see the future scope in section five.

2. LITERATURE SURVEY

Recently, the negative ion technology is widely used to improve the air quality. Negative ions can react with positive ions, decrease the dust in air, and improve the air quality effectively. The method of generating negative ions is breaking the insulation of air by a high voltage electric field. The electrons in the electric field are accelerated, become high-energy electrons. These high-energy electrons collide with gas molecule will cause the energy transfer. If energy is large enough, the gas molecule will dissociate and become high-activity particles, which can react with positive ions and with industrial dust to form harmless particles, improving the air quality. Several negative ion generating circuits have been discussed, which uses about 5kV-7kV high voltage to supply enough energy to produce negative ions [1]-[4]. Two patents use an oscillator to transfer the input dc voltage to a high frequency ac voltage. With a high ratio transformer, the ac voltage is transformed to a high-level ac voltage. A voltage doubler is inserted between the transformer and the output to rectify the ac voltage to a high-level dc voltage. Uses a flyback converter with a high ratio transformer to transfer input voltage to a high-level voltage.

3. DESIGN OF AIR PURIFIER USING IoT

Design of remaining circuit consists of DC fans, relays, DC motor and MQ9 sensors. These mentioned components are connected to the micro controller named as Node MCU ESP8266. This circuit design deals with the controlling connections of the all parts in the circuit to their respective power supply. When the circuit main switch is in ON condition the only component that is in ON condition is the micro controller along with MQ9 sensors which are

directly connected to the 5V DC supply from the power supply circuit. This controller is connected to the internet whenever it is powered ON. The value read by the MQ9 sensors are fed to the controller by connecting the A0 pin of the sensor to the A0 fin of the controller. The readings of the sensor can be seen in the "Blynk" app. The remaining parts of the circuit are in OFF condition. In simple the DC fans negative terminals are connected the ground and the positive terminals are connected to 12V DC positive terminal by means of a relay, the main circuit's one of the terminals is directly connected the 230V AC nuteral terminal whereas the other terminal is connected to the 230V AC phase line by means of an another relay, the positive and negative terminals of the 12V DC motor are connected to the positive and negative terminals of the 12V DC power supply by means of relays one for each terminal such that the polarity is not fixed this helps to achieve the clockwise and anti-clockwise rotation of the motor. All the relays coil terminals are connected to the 12V DC positive terminal and the collector terminal of the respective 2n2222 (NPN) transistors. These transistors contain ground connection to their emitter terminals. Each base terminal of the transistors is connected the micro controller by means of 1k ohm resistor respectively. Here the transistor acts as a switch connecting the other end of the coil in the relay to the ground when the voltage to the base terminal crosses the threshold level. The NC (normally closed) terminal of each relay is connected to the ground. The NO (normally open) terminal of DC fan and DC motor relays are connected to the positive terminal of 12V DC power supply. The NO (normally open) terminal of main circuit relay is connected to the 230V AC phase terminal. The whole circuit is on when the switch in the blynk app is ON and air purifier system is shown in Fig. 1.

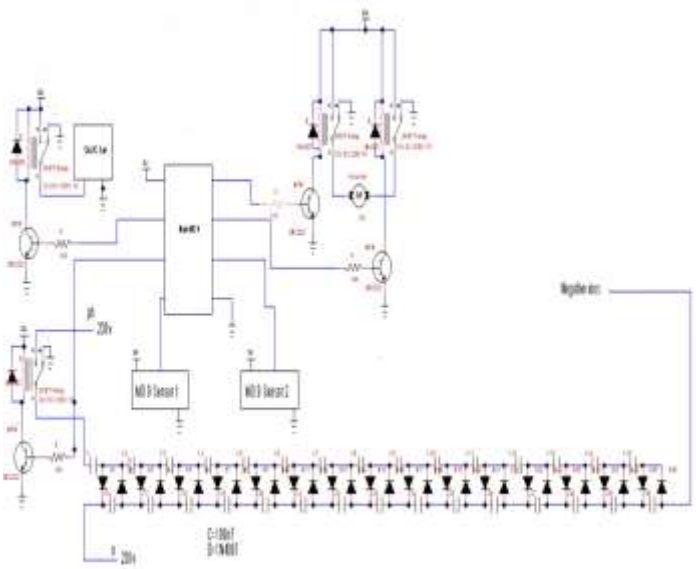


Fig.1 Air Purifier System

The whole circuit is visible to outside as we used acrylic sheet as the cover or body of the circuit. The reason behind using the acrylic sheet is that it has high insolation point and has transparent visibily of the circuit connection; our device is air tight so that we can't take the circuit out each and every time. The transparent nature avoids this problem and hardware air purifier is shown in Fig. 2.

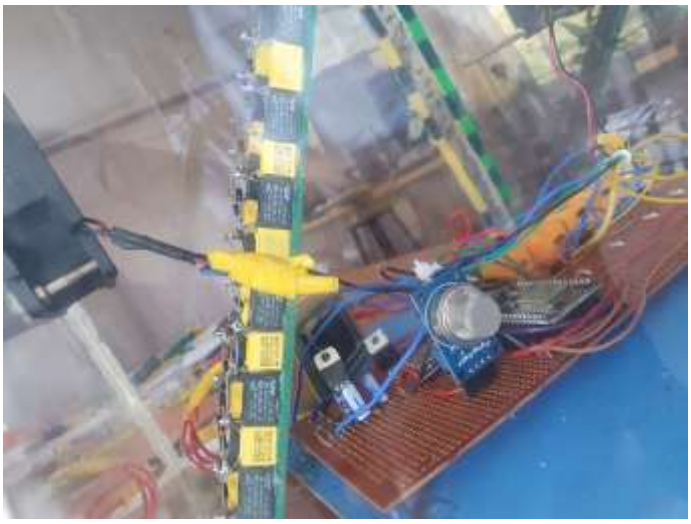


Fig. 2 Hardware of air purifier

Ionization is the working principle of our project. *Ionization* is the process by which an atom or a molecule acquires a negative or positive charge by gaining or losing electrons, often in conjunction with other chemical changes. The resulting electrically charged atom or molecule is called an ion.

The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

$$Rs\backslash RL = (Vc-VRL) / VRL$$

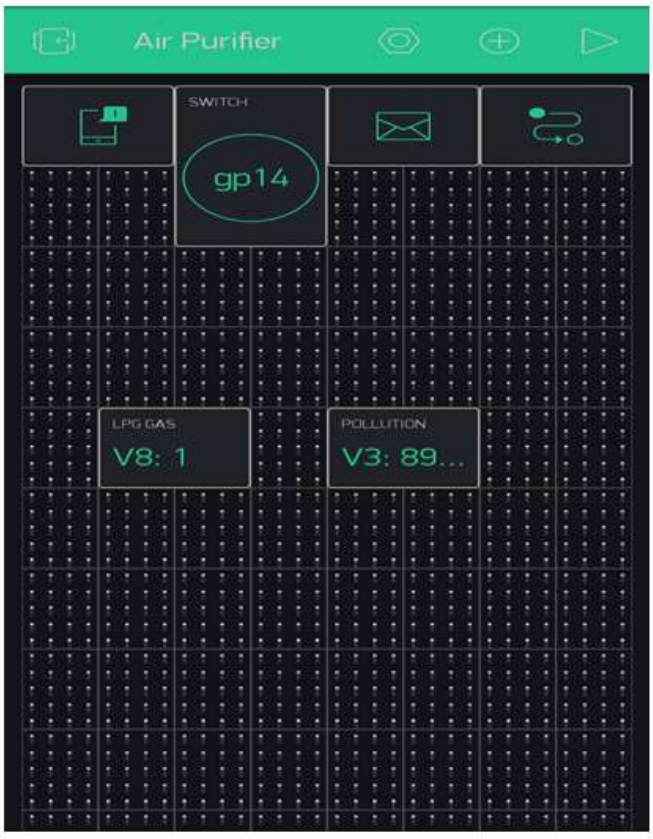
Alterable situation of RL signal output measured by using Fig. 2 circuit output signal when the sensor is shifted from clean air to carbon monoxide (CO) or CH4, output signal measurement is made within one or two complete heating period (2.5 minute from high voltage to low voltage). Sensitive layer of MQ-9 gas sensitive components is made of SnO2 with stability, So, it has excellent long term stability. Its service life can reach 5 years under using condition.

Resistance value of MQ-9 is difference to various kinds and various concentration gases. So, when using these components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 200ppm and 5000ppm CH4 or 1000ppm LPG concentration in air and use value of Load resistance that (RL) about 20 KΩ (10KΩ to 47 KΩ). When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence. The sensitivity adjusting program: a. Connect the sensor to the application circuit. b. Turn on the power; keep time of preheating through electricity is over 48 hours. c. Adjust the load resistance RL until you get a signal value which is respond to

a certain carbon monoxide concentration at the end point of 90 seconds. d. Adjust the another load resistance RL until you get a signal value which is respond to a CH4 or LPG concentration at the end point of 60 seconds.

3. RESULTS

IoT enabled air purifier works efficiently and helps in healthy living by providing purified air .230V ac supply is given to the power supply circuit and it is converted to 12vdc and 5v dc .12vdc is used to drive the dc motor and to all the 4 relays .And the 5vdc is used to drive the NODEMCU. The dc motor rotates and the dc fans inlets the air and it works as it is programmed in the NODEMCU. The whole system is connected to the mobile phone via internet using an online cloud portal called blynk cloud.



If any interrupt is occurred in the blynk app it is transferred to the microcontroller unit through internet. For example, in order to start the device we have to press on button in the blynk app, then the signal is transmitted to the NodeMCU there by it turns on the dc fans, ionizer circuits, dc motor and the sensor connected to the NodeMCU.

The above image shows the output of the air purifier in the blynk application. We can see that it consists of three pins, two Virtual and one GPIO pins. These are connected to digital and analog pins of the board through internet. The virtual pin V3 is connected to A0, virtual pin v8 is connected D4, GPIO14 is connected to D5. We can run the system by pressing the triangle in the right top corner of the blynk app. After pressing the run button, the system looks like the one shown in the above figure. We can switch on and off the device by pressing the switch. If we press the on button in blynk app the signal is transferred to board and the device gets turned on.

The readings of MQ9 sensor can be viewed in the serial monitor. It measures the concentration of carbon monoxide, LPG in air. If the LPG gas concentration in air is more than permissible limit then the sensor enables the d0 pin which gives us the warning through both notification and email.

4. CONCLUSION

The interaction between humans and physical devices and objects is increasing attention. Many studies have attempted to provide a natural and intuitive approach to request services. The current trend of controlling devices with IoT technology offers exciting future developments. The proposed system is also referred on smart-home technology, including the IoT Enabled Air Purifier. The results not only present the key improvement of the Air Purifier system involved in the IoT technology, but also meet the demand of owners. The basic vision behind the IoT, it may have a new way of operational method, it may have a new method of connecting devices, and there might be the even complete clean- slate approach. As the full operational definition is finalized, but there are numerous research issues that can be worked on.

5. FUTURE SCOPE

With the correct libraries and codes used we were able to merge the codes, we have also made the components to work as one with a process that work the way we wanted to. After a series of troubleshooting and code editing, we were

able to create an IoT Enabled Air Purifier that purifies the air in a very efficient way and gives the real time analysis of the carbon monoxide and the lpg gas level concentrations in the air at that place and can be operated from anywhere in the world. Our IoT Enabled Air Purifier has a lot more things to improve. For further and deeper research, they can put more functionalities in our IoT Enabled Air Purifier like putting an additional sensor so that we can able to measure other important gas concentration and also an another sensor which is being used inside is used on the outside (at the device outlet) gives us a way to determine the efficiency of the device.

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