# DESIGN AN SOLAR POWERED AIR PURIFIER WITH AIR QUALITY MONITORING SYSTEM

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**Abstract: Air pollution has become a pressing global concern, impacting human health and the environment. In recent years, the integration of renewable energy sources in various sectors has gained significant attention as a sustainable solution. This paper presents the design and development of a solar-powered air purifier with an integrated air quality monitoring system to tackle the issue of indoor air pollution. The proposed system utilizes solar energy as a clean and abundant power source to drive the air purification process. Photovoltaic panels are employed to convert sunlight into electricity, ensuring continuous operation without reliance on conventional grid power. This approach not only reduces carbon emissions but also provides a cost-effective solution for air purification systems. The air purifier is equipped with advanced filtration technologies to effectively remove harmful particles, allergens, and volatile organic compounds (VOCs) from indoor air. The filtration process is optimized to enhance the air purification efficiency while minimizing energy consumption. Additionally, the system incorporates an intelligent control mechanism to regulate the purification process based on real-time air quality measurements.**

**Key Words: Solar power, air purification, air quality monitoring, renewable energy, indoor air pollution.**

## I. Introduction:

In recent years, air pollution has grown to be a serious environmental issue. The World Health Organization (WHO) estimates that 91% of the world's population resides in areas where air quality is unsafely high [1]. Numerous health issues, including as respiratory illnesses, heart disease, stroke, and lung cancer, can be brought on by exposure to air pollution. To address this problem, solar-powered air purifiers with air quality monitoring systems have emerged as a sustainable solution. These devices use photovoltaic cells to convert sunlight into electricity, which powers the

air purifier and air quality monitoring system. One of the biggest environmental issues now affecting our society is air pollution. It is frequently brought on by activities that have an adverse effect on life, such as mining, building, transportation, artificial work, etc. As is well known, major cities have extremely high levels of air pollution. Numerous health issues are caused by them, including respiratory illnesses, decreased lung function, the emergence of disorders like asthma, etc. The majority of them are larger dust patches, and when their air quality ratings are at their lowest, the air has a genuinely advanced quality that allows all kinds of living things to breathe easily.[1,2]

Although there are many different kinds of air cleaners that may be ordered, none of them are enough to provide their intended operating efficacy. Government associations have a budget for air cleaners that is essentially zero, like unnecessary spending. Therefore, it makes sense to create comparable air purifiers that are more affordable and generally effective. We are thus developing solar-powered air purifiers; however, there is also a problem with power force in internal devices.[2] Then we create an energy independent, heavy duty inner air purifier with air monitoring devices for inner sanctification that is also powered by solar anels. Our solar air cleaner uses a centrifugal suction system to draw air from the cleaner's bottom an pass it through a layer of contaminants to remove adulterants and odor's from the air.

## II. Literature survey:

1. Index of National Air QualityAt the KGiSL I nstitute of Technology in Coimbatore, India, Arun Chakravarthy Ra, Bhuvaneswari Mb, A run Mc, and Sureshkumar C are associate pro fessors of information technology:

For the people, especially for those who see the negative effects of conditions brought on by receptivity to defilement, it is essential to be familiar with step-by-step situations of impurity. The improvement of the landscape is another national achievement. The World Health Organization has taken action to lessen pollution while also improving the standard of living in major cities. An abecedarian thing that is required is a plain or incomprehensible evaluation of air quality. The Air Quality Index (AQI) converts the weighted implicit earnings of each defilement-related limit (such as SO2, CO, sensible quality, etc.) into one grouping of various figures at the outset. This grouping of figures is widely used to check the air quality rate and have a better internal cycle for people across various countries.[3]

2. Characteristics of the Air Particles in the Work Area Associate Professor of Information Technology at the KGiSL Institute of Technology in Coimbatore, India. Arun Chakravarthy Ra, Bhuvaneswari Mb, Arun Mc, and Suresh Kumar C:

Due to the altered rates associated with totally colored perspectives, such as focus, patch size, and patch construction, the identifying proof and representation of particle (PM) prepossessions from developing point exercises beget considerable changes. Additionally, the portrayal of particle is affected by environmental factors as temperature, moisture, and destruction. It includes elements for thorough testing as well as the development of a method to cut down on particle pollution and airborne blow-off. The remaining airborne blotches are likewise

removed. The purpose of this work is to identify and represent PM exoduses on a development point using entirely colourful mechanical distances across (PM2.5, PM10, and all-encompassing suspended particulates (TSP)), backed by a nursing beta investigation. The enhancement point decision criteria, lab systems, field test grouping, and lab disquisition were first homogenized by a convention.[4]

3. Review of an air purifier by Vinoth Sudharsan, Jenifer Sebastian, Kamalesh Raja Gopala Krishnan, Leela Priyanka Chandrasekar, and Gowri Rajapandian Balaji Pandiyan:

Population growth in metropolises is unavoidably a result of urbanization, and this has a terrible impact on air quality, public health, and the environment. Because Indian metropolises are among of the highest weakened metropolises in the world, outdoor air pollution has been a source of concern in India. Particulate pollution significantly worsens the health of the living. Asthma, chronic obstructive pulmonary disease (COPD), reluctance, and wakefulness are illnesses brought on by or exacerbated by growing levels of air pollution. Poor air quality might occasionally provide long-term health benefits. It protects our health against apathy, intrusive doors, and snoring. This review article discusses the factors that contribute to air pollution, the necessity for air cleaners, and how they function.[5]

## III. Methodology:

During day Time the LDR senses the light and the input power for the battery charging and for circuit is from the Solar panel. During no sun light the relay is operated hence the circuit is energized from the battery. The energy generated form solar panel and the battery is converted into required range using converters. This makes the circuit energized and the input sensor readings (inlet/outlet dust, temperature, humidity, gas sensor values) are shown in the LCD display. When the air quality in the inlet dust sensor is below 0.3 the green LED will be ON. When the air dust value gets above 0.3 then the red LED gets ON, and the fans in the inlet and outlet gets on, this makes the dust air flow through the filters and fresh air gets released. The data from the inlet sensors are when there are variations near the sensors. shown in LCD.[6 7]

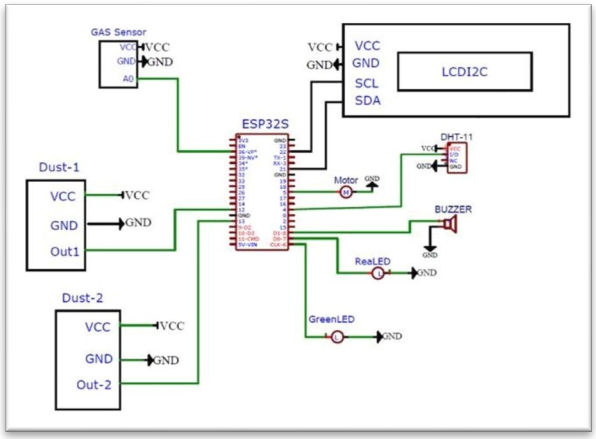


Fig 3.1: Circuit diagram.

The value on the LCD will be change this monitors the air quality in the surrounding place. If air quality is in safe region, then the fan will stop and the model will be ideal so that energy consumption is less. The solar-powered air purifier consists of three main components: a photovoltaic panel, an air quality monitoring system, and an air purifier.[7]

The photovoltaic panel is responsible for converting sunlight into electricity. The size of the panel depends on the power consumption of the air purifier and the amount of sunlight available in the location where the device will be used. The panel is connected to a battery that stores excess energy generated during the day,

which can be used to power the device at night or during periods of low sunlight.[8]

The air quality monitoring system consists of various sensors that measure the concentration of different pollutants in the air, such as particulate matter (PM2.5 and PM10), carbon monoxide (CO), nitrogen dioxide (NO2), and volatile organic compounds (VOCs). The sensors transmit data to a microcontroller, which processes the data and displays real-time air quality data on an LCD screen.

The air purifier filters out harmful particulate matter and volatile organic compounds from the air. The purifier consists of a pre-filter, HEPA filter, and activated carbon filter. The pre-filter traps larger particles, such as dust and hair, while the HEPA filter captures smaller particles, such as pollen and bacteria. The activated carbon filter absorbs doors and volatile organic compounds[8]. The air purifier also includes a fan that draws air into the device and circulates it through the filters. The fan speed can be adjusted to suit the user's preference.

**Block Diagram:**

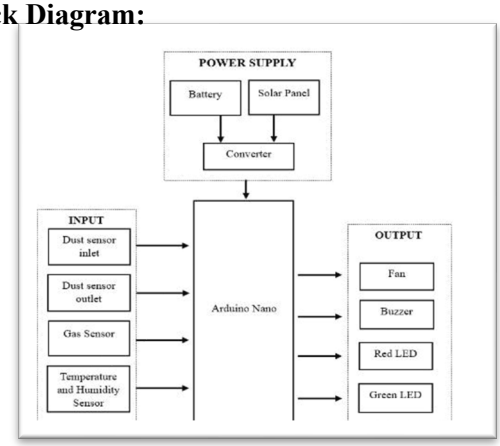


Fig 3.2: Block diagram.

The solar panel generates the power using sun radiations and the generated power is amplified by the solar charge controller, thus battery gets Charged. As we supply the power to the Arduino nano the DH11 & SHARP GP2Y1010AU0F Dust sensor will start sensing the harmful gases and dust particle around it[9,10]. When the air quality is very low in the air inlet sensor then it will indicate red light and also alarm will turn ON. Then fans get turn ON and the surrounding region air gets purifies as their capability. If the data sensed by the sensors are in safe region, then the fan will stop and green light is indicated, this process will repeat again & again. During day Time the LDR senses the light and the input power for the battery charging and for circuit is from the Solar panel. During no sun light the relay is operated hence the circuit is energized from the battery.[11] The solar power aspect of the device makes it more energy-efficient and environmentally friendly. The device can use solar energy during the day to power the air purification system and charge any batteries that are included. This means that the device can continue to operate even during power outages or in areas with limited access to electrici

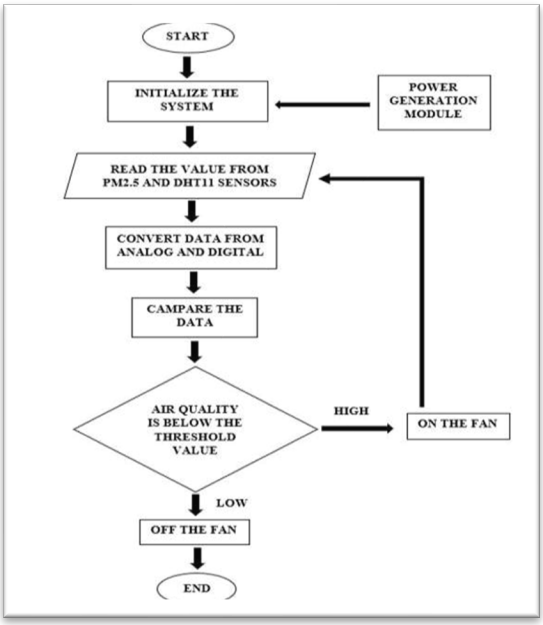


Fig 3.3: Flow Chart.

## IV. Merits, Demerits:

### 4.1 Merits:

- Sensors have long life time & less cost.
- Sensors used in this project are easily available.
- The sensor Operating voltage will be 5 -12 volt.
- As the environment changes there will be continuous update of change in PPM.
- Air purifier is Ideal when there is no pollution, this helps to consume less energy.
- External supply is not required as we use solar panel for the power supply.
- Detecting a wide range of dust and gases, including PM2.5, alcohol, benzene, smoke, CO2, NH3 and NOx.
- Outdoor air quality with temperature and humidity can be measured using sensor.
- Visual output can be seen in the LCD display and also 5V DC output is available for charging purpose.

### 4.2 Demerits

- The filters should be replaced regularly to achieve the efficiency. Maintenance is expensive.
- HEPA filter has high density. It must have a powerful exhaust fan to drive air through it, which is more power-consuming.
- Only filter particles and odors flowing through the air can be filtered.

## V. Result & Discussion:

A solar-powered air purifier with a method to check the quality of the air is provided by this suggested system. The system will be tracking air quality continuously of the surrounding area. the air condition systems do not remove chemicals in gaseous state, or odor from air effectively but if we incorporate the air filtering system with air conditioner, the output air will become highly purified. And it also displays the quality of the air which inlets and outlets after the purification. This proposed system can deliver monitoring in real-time for measurements of air quality.

The project model is combined with two units, one is for power system and another is for purification. The power unit consist of solar panel, battery with converter and relay interfaced with the LDR to indicate day and night condition. The air purifier unit consists of Arduino nano, sensor, LCD display, LED indicators, fans, filters, relays etc. This unit operated based on the program uploaded in the controller. The values of the sensors like inlet/outlet dust, temperature, humidity, gas sensor values displayed on the LCD.

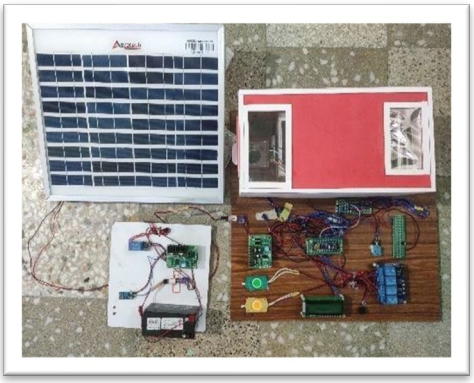

Fig 5.1: Air quality monitoring model

### 5.1 Initial Tests

When the surrounding weather gets changed the sensor will display the values on the LCD. The reading when the model placed outside the room can be seen in the fig 5.2. The fig 5.3 shows the reading when the device kept inside the room. The temperature is mentioned as T, Humidity is

mention as H, the inlet and outlet sensor values are shown in the second line, MQ sensor reading is mentioned as G.

When the inlet sensor value is above 0.3 then the fan gets ON and air purification is done as shown in the fig 5.4. The difference between inlet and outlet sensor values can be seen in the LCD. To operate this unit, we make smoke to occupy in the box and make it operate and purify the polluted air inside it as shown in fig 5.5.


Fig 5.2 Air Purifier placed outside the room


Fig 5.3 Air Purifier model placed inside room


Fig 5.4 Air Purifier values during Purification


Fig 5.5 Gas sensor value

## VI. CONCLUSION

In conclusion, we have designed a solar-powered air purifier with an integrated air quality monitoring system, which offers a sustainable and efficient solution for improving indoor air quality. Our system combines the benefits of renewable energy from solar power with advanced air purification technology and real-time air quality monitoring. The solar-powered air purifier harnesses the energy from the sun through photovoltaic panels, eliminating the need for grid electricity and reducing carbon emissions. This makes it an environmentally friendly and cost-effective solution, especially in regions with abundant sunlight.

To enhance the functionality of the system, we have integrated an air quality monitoring system. This system continuously measures key air quality parameters, such as particulate matter (PM2.5 and PM10), carbon dioxide (CO2) levels, volatile organic compounds (VOCs), and temperature and humidity. The real-time monitoring data is displayed on an intuitive interface, allowing users to easily track and assess the air quality in their surroundings. The air quality monitoring system also includes intelligent features such as adjustable fan speed and automated alerts. When the air quality falls below a predefined threshold, the system automatically adjusts the fan speed to increase air circulation and activates an alert to notify the user. This ensures that the air purifier operates efficiently and effectively in response to changing air quality conditions.

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