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Solar Power Air Purifier with Air Quality Monitoring System

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ABSTRACT: Air pollution is a big problem worldwide, especially with outdoor air quality being a major concern in many places. Even though more people are using indoor air purifiers, having clean outdoor air is still really important. Using solar power for outdoor air purifiers could be a great way to fight air pollution using renewable energy. These solar-powered air purifiers work by turning sunlight into electricity to run fans and filters. They pull in air through the filters, which remove harmful substances. Then, the clean air is released back into the environment, making the air better nearby.

These solar-powered air purifiers could be really helpful in cities where pollution from factories, cars, and other sources can be dangerous for people's health. They could also be used at outdoor events like festivals to improve air quality for everyone there. Using renewable energy like solar power for these systems is good because it reduces our reliance on fossil fuels, which harm the environment. Plus, it helps lower greenhouse gas emissions, which are a big part of climate change. So, solar-powered outdoor air purifiers could make a positive difference in fighting both air pollution and climate change.

KEYWORDS: Photovoltaic Conversion, Filters, Contaminants, Metropolitan Zones, Greenhouse Gas Emissions.

I. INTRODUCTION

Today, the world is in a difficult situation due to Pollution in any form. And in big cities it is high. Most of the pollution comes from vehicles and Civil engineering, gases such as CO2, ground dust, Air particles, abnormal gases, dusty rooms, etc. All health problems if inhaled. The air must Be cleaned of contaminated particles to reduce the likelihood of respiratory illness from Inhalation. Due to air pollution and harmful gases Present in air like CO2, NH3 and burned plastic in Environment it causes respiratory desies like Asthma attack, lungs cancer and other respiratory Desies etc.

When plastic and other waste are burned, they release harmful carbon molecules into the air, increasing air pollution. This pollution can be harmful to people's health, so there's a need to purify the air to make it clean again. There are various devices available in the market to monitor and measure air quality, but they may not be effective enough. Arun Chakravarthy R, Bhuvaneswari M, Arun M, and Suresh Kumar C have suggested placing these devices in places like transportation hubs, near hospitals, and traffic signals. Both government organizations and private companies are working to reduce air pollution and improve air quality. One solution is to use air purification systems, especially in areas with high levels of pollution. Our idea is to create a solar-powered air purifier with a monitoring system. It includes components like a turbine, fan, pump, and battery powered by solar energy. This system can help remove harmful particles, including moisture, from the air. With The help of LED display show & 39; s the pure air Is exhaust in environment. Due to increase in Cities, industries and In cities, there's a lot of growth in industries that create pollution, like factories. People often burn trash and leaves in the open, which adds to the problem. There's also a ton of waste from construction projects, and we're losing a lot of forests. Plus, there are a lot of cars on the roads, especially ones that run on diesel, which adds even more pollution. All of this pollution is really bad for our health The Regularly monitoring in air is important because Of this the quality of air is looks and appropriate Solution is provided. The primary contributor to air pollution is the (PM) Means particulate matter because of this causing Human health is not in good condition, it causes Respiratory desires like asthma and other Respiratory illnesses.

The solar air monitoring and Filtration system runs on solar energy using Components such as solar panels, Arduino UNO Microcontroller, sensors (MQ135, MQ2, MQ6), Relay batteries, etc. Now a days the air pollution is common

issue because of air pollution causes various environmental problems. The (WHO) World Health Organization almost declares that 91% of the world's people's lives in areas where air quality is dangerously high. Due to air pollution can cause a number of health problems, including respiratory disease, heart disease, stroke and lung cancer. To solve this problem, solar air purifiers with air quality monitoring systems have emerged as a sustainable solution.

II. LITERATURE REVIEW

Big cities in India have a big problem with dirty air, and it's really bad for people and nature. This pollution is getting worse quickly. Cars and factories are the main reasons for this dirty air, and it's making a lot of people sick with breathing problems like asthma. Places like Kolkata, Delhi, and Mumbai have the worst air because there are so many cars and factories there, releasing harmful gases like carbon dioxide. Many studies have shown ways to measure air pollution using inexpensive devices that people or Mujawar and his team designed an system to measure air pollution in Solapur city using wireless sensor networks (WSN). Tiny sensor nodes pick air pollution by measuring how well electricity flows through an special layer.

1. At the KGiSL Institute of Technology in Coimbatore, India, there are associate professors of information technology named Arun Chakravarthy Ra, Bhuvaneswari Mb, Arun Mc, and Sureshkumar C. They are studying the air quality index. It's important for people, especially those affected by pollution, to understand how pollution levels change over time.

2. At the KGISL Institute of Technology in Coimbatore, India, there are associate professors of Information Technology named Arun Chakravarthy Ra, Bhuvaneswari Mb, Arun Mc, and Suresh Kumar C. They are studying the characteristics of air particles in work areas. They're looking at things like color, size, and structure of particles to identify and understand them better

1.Air Pollution and Its Impact Environments:
Urban areas face significant challenges related to outdoor air pollution due to vehicular emissions, industrial activities, and urbanization. Studies consistently highlight the adverse effects of air pollution on public health, emphasizing the need for innovative interventions to combat this growing problem.

2.Solar Powered Air Purifier System:
The integration of solar power into air purification systems is a promising solution. Research in this area has focused on the development of high-efficiency photovoltaic cells and energy storage systems, ensuring uninterrupted operation of air purifiers. Studies emphasize the importance of optimizing solar power utilization to maintain consistent air purification levels

3.Advanced Air Quality Monitoring System:
Real-time air quality monitoring systems have evolved with advancements in sensor technologies, data analytics, and IoT integration. These systems provide accurate, granular data on pollutant levels, enabling precise analysis of pollution patterns.

4. Community Engagement and Social Impact:
Successful mega projects necessitate strong community engagement. Literature emphasizes the role of social awareness campaigns, citizen science initiatives, and participatory approaches to involve communities actively. Engaged communities are more likely to support and sustain the project, fostering a sense of ownership and collective responsibility for clean air

5.Policy Framework and Government Support:
The support of governmental bodies through policy framework and financial incentives is crucial for the implementation of mega projects Studies showcase the impact of policies such as emission standards, congestion pricing, and subsidies for renewable energy technologies. Collaborative efforts between governments, NGOs and private sectors are pivotal for scaling up solar- powered air purification initiatives

III. METHODOLOGY

During the day, a light sensor detects sunlight and uses it to charge a battery and power the circuit through a solar panel. When there's no sunlight, a relay switches on, and the circuit runs on the battery's power. Energy from the solar

panel and battery is converted into the required form using inverters. This powers the circuit and displays sensor values (such as dust, temperature, humidity, and gas levels) on an LCD display. If the dust level measured by the inlet sensor is below 0.3, a green LED lights up. If the dust level exceeds 0.3, a red LED turns on, and both inlet and outlet fans start running. This action helps filter dusty air, releasing fresh air into the environment.

The data from the input sensors are when they are near the deviation sensors. The results shown on LCD display.

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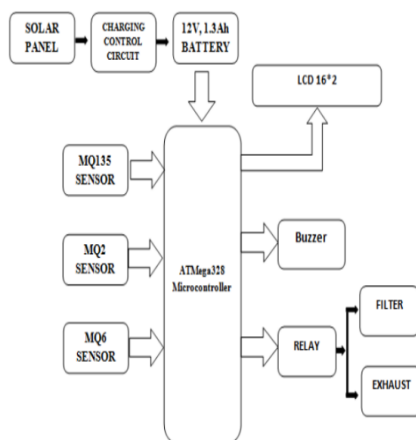
The Arduino Uno is connected to three different sensors: MQ135, MQ2, and MQ6. These sensors can detect various things in the air, like pollution or gas levels

REQUIRED COMPONENTS

Arduino UNO:

Arduino is an open-source, programmable circuit board built on simple hardware and software. The device includes 14 digital input/output pins, 6 analog inputs, a USB port, a power jack, an ICSP header, and a reset button. To power the board, connect it to a laptop via USB cable.

ESP8266:

The ESP8266 12-E chip has 17 GPIO pins, but not all of them are available on every ESP8266 development board. Some GPIO pins are not recommended for use, and others have specific functions. This guide will teach you how to use the GPIO pins of the ESP8266 properly, helping you choose the best pins for your projects and avoiding frustration

GAS SENSOR:

A gas sensor typically consists of a steel outer shell with a sensing element inside. These sensors are used to detect the presence of gases in the environment and monitor how gases naturally move around.

SOLAR PANAL:

12V,9A. The recommended charging current is between 10 and 30 percent of the rated capacity. So a 9Ah battery should be charged at about 2.5A, or lower. Once the battery is fully charged the current drops to a few percent of the rated Ah, which indicates the battery is charged.

Battery:

Rechargeable batteries store power and can be refilled by sending electricity to them after they're used up. They can be used many times, which means less trash and better value for using gadgets.
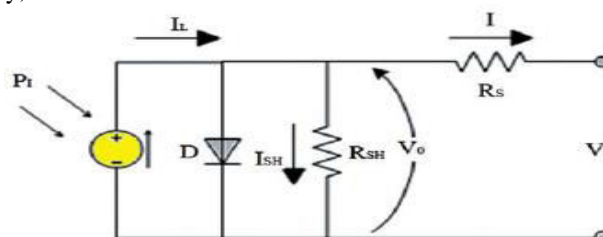
SYSTEM DESCRIPTION:

The picture shows a current source and a diode connected together. A PV array is made by linking many solar cells together in rows and columns.

Were

V_{oc} = open circuit voltage,

I_{mp} = peak current and

P_{max} = maximum power. Initially,

MAXIMUM POWER POINT TRACKING:

Using MPPT helps get the most power from the solar panel no matter the weather. It definitely makes the solar panel work better. We're using a method called perturbation and observation to do this. In this method, we first measure the current and voltage of the solar panel. Power is calculated by multiplying these two values.
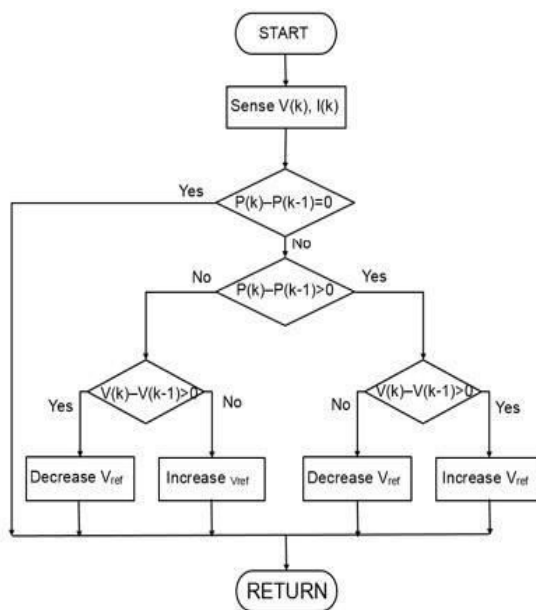

FIGURE 1 MPPT flowchart

If the current voltage is lower than before, the duty cycle decreases in a zeta converter. But if the current voltage is higher than before, the duty cycle increases. This process is repeated within a loop in the code.
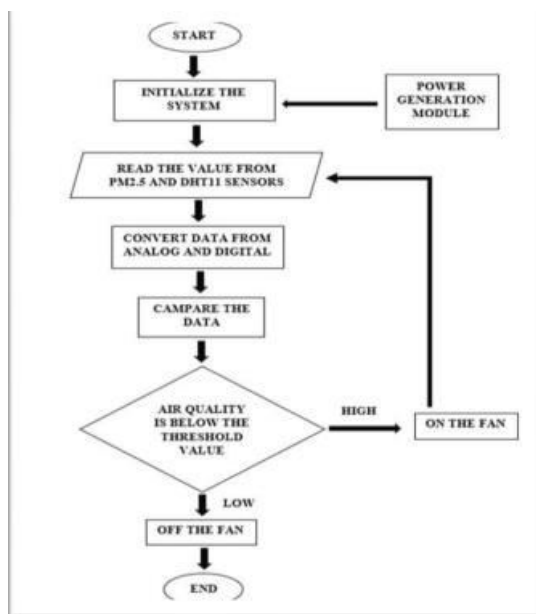

FIGURE 2 Flowchart for Monitorning Vehical

The same process is then repeated in a new loop, with the aim of measuring the new voltage and current that are produced as a result of the buck converter's freshly configured duty cycle. For a better understanding, please see the flowchart above

APPLICATION AND ADVANTAGES
Application:
1.Urban Parks And Recreational Areas
 2.Street-Side Installation
 3.Outdoor Events And Festivals, etc
Advantages:
There are some advantages of this Project. Which are listedbelow –
Environmental Sustainability
Off-Grid Operation
Cost Saving
Low Maintenance Requirements
Quiet Operation
Modular And Scalable Design

IMPLEMENTATION

Here the proposed model is made up of hardware which waspreviously explained in the description of the system
STEP1
When all the components are activated, Solar powered air purifier works continuously and purifier the air properly
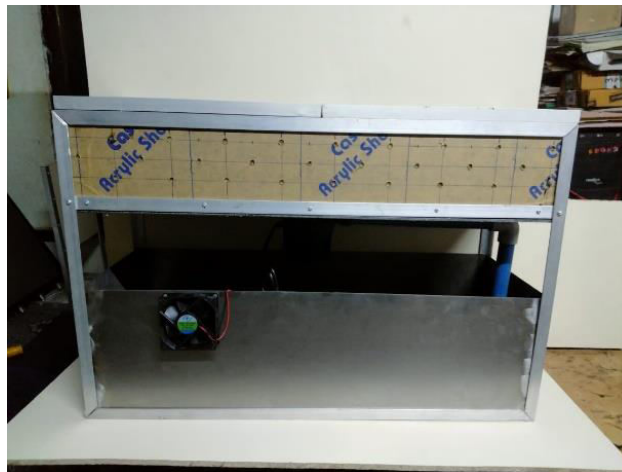
IV. RESULT

Air quality monitoring of air quality This system is designed to monitor and clean the air around us.

PM 2.5	AIR QUALITY INDEX	PM2.5 HEALTH EFFECTS
0 -13.0	Good [0-50]	Little to no risk
13.1-36.4	Moderate[51-100]	sensitive individuals experience respiratory symptoms

36.5-56.4	Unhealthy sensitive group [101-150]	Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease
56.5-151.4	Unhealthy [151-200]	Premature mortality in with cardiopulmonary disease and elderly
151.5-251.4	Very unhealthy [201-300]	This means that if you have heart or lung problems, they can get much worse. It also means that people, especially older ones, can die earlier because of this. And for everyone, there can be more breathing problems.
251.5-600.4	Hazardous [301-500]	serious aggravation of heart or lung disease

V. CONCLUSION

In summary, we've created a solar-powered air purifier with a built-in air quality monitor to improve indoor air quality effectively and sustainably. Our system uses solar energy from panels, reducing reliance on electricity and cutting carbon emissions. It's eco-friendly and cost-efficient, especially in sunny areas. We've added features like adjustable fan speed and alerts to make it smarter. If air quality drops, the fan speeds up automatically, and an alert notifies the user. This ensures the purifier works well and responds to changes in air quality.

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