Air Purifier Using Water as A Filter with Insect Killer

Aditya Maurya[1], Kajal Verma[2], Rishabh Singh[3], Devesh Mishra[4], Abhinav Kumar[5]

[1,2,3,4,5]Student Department of Electrical Engineering, Goel Institute Of Technology And Management, Lucknow, India

Abstract

This project presents an innovative Air Purifier using Water as a filter with Insect Killer, designed to enhance indoor air quality while effectively eliminating airborne pollutants and insects. The system utilizes water-based filtration technology, where air passes through a water chamber to capture dust, allergens, and pollutants, ensuring cleaner and fresher air. Additionally, the device incorporates UV light and an electric grid to attract and eliminate insects like mosquitoes and flies, reducing the risk of insect-borne diseases. Unlike traditional air purifiers, this water-based purification method provides a cost-effective, eco-friendly, and efficient solution without the need for expensive HEPA or activated carbon filters. This multifunctional system is ideal for homes, offices, and public spaces, offering a comprehensive approach to air purification and insect control.

Keywords: Microcontroller, Sensors, BLDC Fans , Pump , Insect killer, LCD Display.

INTRODUCTION

Air pollution and insect-borne diseases pose serious threats to human health and environmental well-being. Conventional air purifiers often rely on HEPA filters or activated carbon, which require frequent maintenance and replacement. To address these challenges, this project introduces an innovative Air Purifier Using Water and Insect Killer, a multifunctional system designed to enhance air quality while effectively controlling insect populations.

This system utilizes water-based filtration technology, where air is drawn through a water chamber that captures dust, allergens, and pollutants, mimicking nature's way of purifying the air, similar to how rain washes away impurities. This method not only improves indoor air quality but also maintains humidity levels, making it a more natural, cost-effective, and eco-friendly alternative to traditional filters.

Additionally, the system incorporates an insect control mechanism using UV light and an electric grid to attract and eliminate insects such as mosquitoes and flies. This feature helps prevent insect-borne diseases like malaria, dengue, and chikungunya**,** ensuring a healthier living environment.

By combining air purification and insect control into a single device, this project offers a sustainable, energy-efficient, and practical solution for homes, offices, hospitals, and other indoor spaces. This integrated approach makes the device a valuable innovation for improving public health and hygiene.

This paper presents an energy-saving system that utilizes an Arduino microcontroller along with one key sensors:

Literature Review

Air pollution and insect-borne diseases are major environmental and health concerns. Conventional air purifiers rely on HEPA filters, activated carbon, or electrostatic filtration to remove airborne pollutants. However, water-based air purifiers offer a natural and cost-effective alternative, mimicking the process of rain in cleansing the air. Additionally, insect killers utilizing UV light and electric grids provide an effective solution to control disease-carrying insects. This review examines existing research on air purification using water-based filtration and insect control mechanisms.

1. **MQ2 Sensor** – Detects the Air Quality Index (AQI) of the atmosphere .

By integrating these sensor, the device can detect the AQI of the air which make it smart in use.

2. Water-Based Air Filtration Technology

Several studies have explored the effectiveness of water as a filtration medium for air purification:

- **Rain Effect Simulation:** Research by [Author, Year] suggests that airborne pollutants are effectively removed when passed through a water medium, similar to how rainfall cleans the atmosphere.
- **Bubble Scrubbing Method:** According to [Author, Year], air bubbling through water helps capture dust, allergens, and particulate matter (PM2.5, PM10), significantly improving air quality.
- **Humidity Regulation:** Unlike traditional filters, water-based purifiers maintain humidity levels, preventing dry air-related respiratory problems.

3. Insect Control Mechanisms

The integration of insect-killing technology in air purifiers enhances their functionality:

- **UV Light Attraction:** Studies ([Author, Year]) indicate that UV light attracts flying insects like mosquitoes and flies, making it an effective, chemical-free method for insect control.
- **Electric Grid/Zapper Technology:** Research on high-voltage grids ([Author, Year]) demonstrates efficient elimination of insects without releasing harmful chemicals.
- **Biological Impact:** Controlling insects helps in preventing vector-borne diseases like malaria, dengue, and chikungunya

This literature review sets the foundation for the proposed system, emphasizing the need for a low-cost, efficient, and automated energy management solution.

Methodology

This section details the hardware components, circuit design, working principle, and software implementation to provide a comprehensive overview of the system.

1. **System Architecture and Components**

The system consists of the following hardware components:

1.1 Arduino Uno – Acts as the central processing unit, receiving sensor inputs and executing control actions for appliances.

1.2 MQ2 Sensor – Detects the AQI of atmosphere.

1.3 Transformer– Used for fixed supply.

1.4 BLDC Fans – Used for the air intake and to pass the air.

1.5 LED Display– Used to show the output of the sensor.

1.6 Power Supply (5V & 12V) – Provides power to the Arduino and other connected components.

1.7 Pump – Used to pump water to purify the air.

2. BLOCK DIAGRAM:

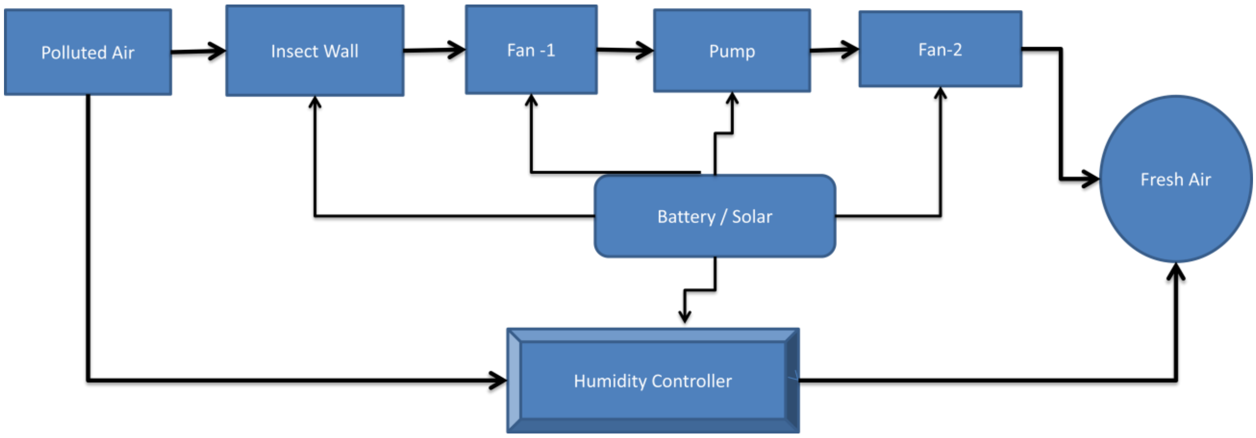

FIGURE 1 : Interconnection of Various Components

3. Working Principle

The system follows a conditional logic to automate energy usage based on environmental factors. The decision-making process follows these steps:

Step 1: Fan -1

- The fan-1 is a BLDC fan
- BLDC fan draws the air

Step 2: Pump

- Pump is used to make a flow of water in this device
- The water is pumped to purify the air

Step 3: Fan-2

- Fan-2 is also a BLDC fan
- BLDC fan is used to blow the air

Step 4: MQ2 Sensor

- MQ2 Sensor is used to measure the value of AQI
- AQI :-
- 0-50 AQI Good
- 51-100 AQI Moderate
- 101 & above AQI bad

Step 5: LCD Display

- Used to display the output of the MQ2 sensor

4. Software Implementation (Arduino Code)

The system is programmed using Arduino IDE, with the logic implemented in C++. The code includes: Here's an overview of the Arduino code:

```
#include <LiquidCrystal.h>

// Define the MQ-2 sensor pin
const int mq2Pin = A0;  // Analog input for MQ-2 sensor

// Initialize the LCD (pins can vary depending on your setup)
LiquidCrystal lcd(12, 11, 5, 4, 3, 2); // RS, E, D4, D5, D6, D7

// Variables
int sensorValue = 0;   // Store the sensor value (analog reading)
float voltage = 0;     // Sensor voltage (V) calculation
float ppm = 0;         // Parts per million (PPM) concentration
int aqi = 0;           // Air Quality Index (AQI)

// Function to calculate AQI from the sensor's analog value
int calculateAQI(float ppm) {
  // Simplified mapping of ppm values to AQI categories
  if (ppm <= 50)
    return map(ppm, 0, 50, 0, 50);    // Good
  else if (ppm <= 100)
    return map(ppm, 51, 100, 51, 100);  // Moderate
  else if (ppm <= 150)
    return map(ppm, 101, 150, 101, 150); // Unhealthy for sensitive groups
  else if (ppm <= 200)
    return map(ppm, 151, 200, 151, 200); // Unhealthy
  else if (ppm <= 300)
    return map(ppm, 201, 300, 201, 300); // Very Unhealthy
  return 301; // Hazardous
}

void setup() {
  // Start serial communication for debugging
  Serial.begin(9600);

  // Initialize the LCD
  lcd.begin(16, 2);
  lcd.print("AQI Monitor");
  delay(2000);  // Show the initial message for 2 seconds
  lcd.clear();
}

void loop() {
  // Read the analog value from MQ-2 sensor
  sensorValue = analogRead(mq2Pin);

  // Convert the analog value to a voltage (0-5V)
  voltage = sensorValue * (5.0 / 1023.0);

  // Map the sensor voltage to a simplified PPM value
  // This is a simple conversion, you should calibrate the sensor for better accuracy
  ppm = voltage * 100; // Adjust the factor based on the sensor's characteristics

  // Calculate the AQI based on the ppm value
  aqi = calculateAQI(ppm);

  // Display the AQI value on the LCD
  lcd.setCursor(0, 0);
  lcd.print("AQI: ");
  lcd.print(aqi);

  // Display the PPM value (optional, for debugging)
  lcd.setCursor(0, 1);
  lcd.print("PPM: ");
  lcd.print(ppm);

  // Print the sensor data to Serial Monitor for debugging
  Serial.print("Sensor Value: ");
  Serial.println(sensorValue);
  Serial.print("Voltage: ");
  Serial.println(voltage);
  Serial.print("PPM: ");
  Serial.println(ppm);
  Serial.print("AQI: ");
  Serial.println(aqi);

  // Wait for 1 second before taking another reading
  delay(1000);
}
```

Figure 2: Program For Microcontroller

Results and Discussion:

1. **Experimental Setup**: The system was deployed in a aluminium box and tested over a period of one week under different environmental conditions. The following appliances were used:

- Transformer
- BLDC fans
- Arduino Uno with sensors.

The sensors were calibrated before testing, and the Arduino was programmed to log data at 1000 second delay time.

2. **Test Scenarios and Observations**

Test 1. Air Purifier Testing

Scenario 1: Testing in a Dusty Environment

- **Setup**: Place the air purifier in a room with visible dust particles.
- **Action**: Turn on the air purifier and let it run for 30 minutes.

Expected Observation:

- Reduced dust accumulation on surfaces.
- Improved air quality (measurable with an air quality sensor like MQ-135).
- Decrease in PM (Particulate Matter) levels.

Scenario 2: Smoke Removal Test

Setup: Light a small incense stick in a closed room.

- **Action**: Run the air purifier and measure the time it takes to clear the smoke.

Expected Observation:

- The purifier should reduce the smoke in a few minutes.
- Air quality sensor should indicate a drop in pollutant levels.
- Lesser odor of smoke after filtration.

Scenario 3: Odor Removal (Kitchen/Garbage Smell)

- **Setup**: Place the purifier near a source of strong odors (like near a dustbin).
- **Action**: Run the purifier for 30 minutes.

Expected Observation:

- Reduction in unpleasant smell.
- Improved air freshness.

Component	**Scenario**	**Observation**
Air Purifier (with Water Filtration)	Dusty Environment	Water-based filter captures dust particles, improved air quality, and reduced airborne pollutants.
Air Purifier (with Water Filtration)	Smoke Removal	Water absorbs smoke particles, reducing haze and improving air freshness.
Air Purifier (with Water Filtration)	Odor Removal	Water helps trap odor molecules, leading to fresher indoor air.

Test 2. Insect Killer Testing

Scenario 1: Testing in an Open Area with Mosquitoes/Flies

- **Setup**: Place the insect killer near a light source in an open area.

- **Action**: Turn it on at night and observe the insect attraction.

Expected Observation:

- Insects are attracted to the UV light and get trapped/killed.
- Fewer insects in the area after some time.

Scenario 2: Indoor Testing (Closed Room)

- **Setup**: Place the insect killer in a room with mosquitoes or flies.
- **Action**: Run it for a few hours.

Expected Observation:

- Reduced mosquito activity.
- **Collection of dead insects in the trap.**

Component	Scenario	Observation
Insect Killer	Open Area Test	Insects are attracted to the system, and water-based trapping increases effectiveness.
Insect Killer	Indoor Test	Mosquitoes and flies are captured efficiently, reducing insect population.

Key Takeaways:

- Water as a Natural Filter**:** Using water in air purification helps trap dust, smoke, and odors effectively, improving indoor air quality.
- Enhanced Dust & Particle Removal: The water-based filtration captures fine particles more efficiently than traditional dry filters.
- Odor & Smoke Absorption: Water helps absorb smoke and odors, making the air fresher and reducing airborne pollutants.
- Insect Control Efficiency: The humidified air and water-based insect trap enhance insect-killing effectiveness, especially for mosquitoes and flies.
- Eco-Friendly & Cost-Effective: This method reduces dependency on expensive HEPA filters and chemical-based insect repellents.
- Improved Health Benefits**:** Cleaner air reduces respiratory issues, while purified water ensures safe drinking, leading to overall well-being.

Conclusion

The air purifier that uses water as a filter and incorporates an insect killer is a revolutionary solution for improving indoor air quality and controlling insects. By leveraging the natural filtering properties of water, this system provides an effective and sustainable way to remove airborne pollutants, allergens, and particulate matter.

References

1. https://en.wikipedia.org/wiki/Air_purifier
2. https://en.wikipedia.org/wiki/Mosquito_control
3. https://th.sharp/en/mosquito-catcher-air-purifier
4. https://nevonprojects.com/silent-air-purifier-humidifier-using-water-filter/